MILK PRODUCTION SYSTEMS PROJECT (GUYANA)

EVALUATION REPORT

PREPARED FOR THE

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE

By

Gustavo Cubillos, Animal Production Specialist
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Acknowledgements

The insights that the consultants gained into the details of the Milk Production Systems Project (Guyana) would not have been possible without the valuable contribution of many people in Guyana and Trinidad and Tobago. While some of these insights are reflected in this report, they remain the sole responsibility of the Evaluation Mission.

Especially helpful were the discussions with Dr J.W. Smith, Project Leader, whose expertise and knowledge of the overall project and its linkages both nationally and regionally allowed the Mission to more objectively evaluate the MPSP within the framework in which it is set.

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ACRONYMS

CARDI	Caribbean Agricultural Research and Development Institute
CARICOM	Caribbean Community and Common Market
CIAT	International Center for Tropical Agriculture
CIDA	Canadian International Development Agency
EDF	European Development Fund
EEC	European Economic Community
FAO	Food and agriculture Organization of the United Nations
GMP	Georgetown Milk Plant
IARCs	International Agricultural Research Centres
IDB	Inter-American Development Bank
IDRC	International Development Research Centre
IICA	Inter-American Institute for Cooperation on Agriculture
LIDCO	Livestock Development Company
MMA	Mahaica, Mahaicony and Abary Agricultural Development Authority
MPSP	Milk Production Systems (Guyana) Project
NARI	National Agricultural Research Institute
NDDP	National Dairy Development Programme
RISPAL	Red de Investigación en Sistems de Producción Animal de Latinoamérica (Animal Production Systems Research Network for Latinamerica)
UG	University of Guyana
UWI	The University of the West Indies
WHO	World Health Organization

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EXECUTIVE SUMMARY

A Mission composed of an animal production specialist, a dairy production specialist and an agricultural economist was assembled for an external evaluation of the Milk Production Systems (Guyana) Project which has been carried out since January 1982 through three consecutive phases.

The Mission began work on June 17 and lasted until July 5, 1991, making a review of the work done regarding:

a) diagnosis and characterization of the production systems,

b) research on its components by discipline and ecological area,

c) physical model proposal and related activities associated to their testing.

In addition, the Mission evaluated the conditions under which research activities were conducted, the methodology used and achievements during the three phases of the Project. Recommendations that can be used at the National, Regional and donor institution level were arrived at after this evaluation.

The Mission members visited Guyana, and Trinidad and Tobago to review the available information, collect information at project sites, and interview authorities at the Regional and National institutions, as well as Project staff members.

Trade deficits in the Caribbean countries are high, particularly as refers to food and food items, and as such, need to be addressed as one of the possible areas where intra regional trade and cooperation will yield the most benefits. With this in mind, the main goal of the rationalization of agriculture within the Caribbean Community is to significantly increase and improve the level of production, productivity, and profitability of agricultural enterprises; to provide increasing levels and a better distribution of real per capita income for the Region's producers and traders; and to increase the flow of high-quality competitively priced food and non-food commodities to regional consumers, the tourist trade and to extra-regional markets.

To accomplish the above mentioned goal, needs have been identified and integrated into a regional development plan for agricultural integration in the CARICOM for optimum utilization of agricultural resources, improvement of agricultural production efficiency, increase in the standard of living and income of rural population and expansion of agricultural production for export within and outside the Caribbean Common Market, among others.

The role of agricultural technology generation and transfer has been recognized as an integral part of this strategy. CARDI, founded in 1975, by the Governments of the Caribbean Community as an autonomous organization is to play a key role in this endeavour of CARICOM. As such, CARDI has been designated by the Standing Committee of Ministers of Agriculture of the Caribbean Community as the administrative agency for the Caribbean Agricultural Research Co-ordinating Committee. It also serves as the regional branch office of the Technical Centre for Agricultural and Rural Co-operation, an international agency specializing in technical information transfer.

CARDI's main activities centre on providing for the research and development needs of the region as identified in national plans and policies, generating and extending the application of new technologies in production, processing, storage and distribution of the agricultural products of member countries, and providing the coordination and integration of the research and development efforts of member countries where this is possible and feasible.

In June 1988 CARDI put out a Strategic Plan 1988/93 which prioritizes the various actions to be taken in order to meet its stated objectives . Of special importance within the context of the MPSP, CARDI's Animal Production Programme is aimed at import substitution to reduce the huge food import bill through the development of forages the expansion of improved pastures; the utilization of by-products in feeding systems and the development of feed from local ingredients; and the improvement of dairy and beef production systems.

Since 1982, as part of its overall mandate in reducing the food import bill, CARDI, with the support of Canada IDRC, has carried on the Milk Production System Project in Guyana with the objective of demonstrating the potential of forage based production systems to increase milk and meat production in the CARICOM countries.

The project has developed within a distorted macro economic framework; however, at the end of 1987, Guyana's external payment arrears reached US$1.1 billion, almost four and one-half exports and thrice GDP. With limited resources, and recent experience of economic and financial imbalance, Guyana has begun a strict economic recovery programme, the highlights of which included austere fiscal policies and elimination of the distortions in the exchange rate policies. Limited application of these measures was not successful in reverting the decline in GDP which fell by 3.1 per cent in 1988 and again by 5.6 per cent in 1989. As a result, further measures to liberalize the economy have been put in place, tightening government spending and freeing the exchange rate.

Agricultural activities are concentrated in the coastal areas of the country. They represent the largest productive sector, generating some 25 per cent of the total GDP, over 50 per cent of all foreign exchange and providing employment to slightly more of 100,000 people (37.5 per cent of the national work force).

Agriculture provides for the bulk of the domestic food supply and is the second source of foreign exchange earnings. Sugar and rice provide about 60 per cent of agricultural GDP, livestock activities provide only about 6 per cent, however some 85 per cent of the sugar crop is exported and rice constitutes another important export product. Therefore, livestock production is not only important in terms of domestic food supply but as a potential earner of foreign exchange.

Agricultural sector policy is imbedded in the general context of the country's macroeconomic policy. Strategic and limited investments to revitalize the sugar and rice industries coupled with the elimination of distortions and privatization schemes for GUYSUCO, LIDCO and the rice mills are foremost on the current policy agenda.

At the same time, the Government of Guyana recognizes the need to cut down on food imports and substitute with local production many of the imported goods; as such, milk production increases are of paramount importance within this new policy framework.

On the specific dairy policy side, the Guyanese government has pursued, in principle an overt policy of favouring milk production; the Moblissa Dairy Unit, the creation of NDDP, the involvement of LIDCO in milk production and marketing, and GUYSUCO's Versailles Milk Complex attest to this effort.

The 1987 - 1990 Agricultural Sector Plan aimed among other things to achieve a rapid increase in aggregate output and productivity in the overall agricultural sector. Within the livestock and dairy subsectors, major emphasis was to be placed on the improvement and expansion of milk production.

Milk production is carried out mainly in the Coastal area from the Pomeroon to the Corentyne rivers, thus including Regions 2 through 6. In this area a very high percentage of the 250,000 head which comprise Guyana's cattle population is located.

According to Mission estimations some 40,000 cows are milked yearly each of them producing around 800 litres per lactation. The total cow population amounts to some 97,000 thus about 41 per cent of the existing cows are milked.

Although local production has shown continuous growth since the early eighties, imports (in particular EEC skimmed powder milk and butter oil) continue to play an important role in the country's domestic milk supply and, primarily in the urban markets.

Milk production continues to be insufficient to meet demand, donated imports continue to be sold at lower than world market prices and therefore discourage local production, milk collection by GMP has been discontinued, and there appears to have been a substantial drop in marketed production.

In reviewing the Project accomplishments, it is the Mission's opinion that the methodological issues, as seen from the point of view of execution of a project, and have been raised in the last Progress Report, constitute an example of the deep knowledge and common use of the methodology by project staff members.

The general objective for Phase I was to demonstrate that the output of livestock products and the net incomes from farmers can be increased by the development of livestock production systems based primarily on forages and local by-products. This objective was, certainly not possible to attain at that time with the limited knowledge about the production systems and the environmental and ecological conditions in which these systems functioned.

The general objectives of the subsequent two phases reflecting perhaps a certain degree of caution, gained by appreciating the difficulty of the task at hand, appeared much more modest in scope.

However, the initial objective appears now possible to be reached and has provided the guidance for the three phases of project activity in Guyana.

In reviewing the objectives of the three phases from the vantage point of hindsight it can be sensed that these have become progressively more realistic and practical as the involvement of CARDI and IDRC in Guyana has continued. Knowledge gained by project personnel, during each phase, both from component research and practical knowledge have been reflected in the objectives and activities proposed for the subsequent stage. At the same time, refinements in the conceptual approach through continuous participation in the RISPAL network have also helped to shape project goals.

On balance, the objectives for each phase do reflect a continuum from the methodological point of view as well as from the accumulated knowledge gathered from systems characterization and research activities.

On the issue of methodology it is necessary to emphasize that at each stage of the project a different thrust was required. The project personnel has been

able to handle this quite well, either through internal discussions or on the advise of outside consultants, and made the necessary changes to reorient the project activities in the required direction.

In general, it can be said that Phase I of the project yielded encouraging results on the technical solutions to agronomic and livestock management constraints. Results were encouraging enough to believe that in a subsequent phase, they could contribute to the design of an economically efficient milk production system.

Phase II was initiated on February 1985 and it aimed to capitalize on the knowledge gained in Phase I. At the same time, it was to broaden its scope of attention to the milk farmers in the Coast of Guyana, the region which provided the bulk of milk consumed by the population. It was also evident that conditions for specialized dairies in Moblissa were not adequate. The inclusion of a new area required a shift of priorities and the strengthening of the conceptual elements of the systems approach.

In an overall sense Phase II sees the strengthening of the Project in two aspects: a better understanding and grasp of the methodological issues involved in the production systems approach, and the informal conformation of an animal production research group within Guyana in which the Milk Production Systems Project was to be the nucleous of activity and provide the leadership.

Phase III was initiated in February 1989 after one year extension of the Phase II. Based on the results obtained it was expected that, for the Coastal area, the main thrust would be on the testing and refinements of the alternative models proposed. Research to complete needed information to improve on the recommended systems and "maintenance" research was to be carried out concurrently.

Phase III consolidates the informal institutional linkages arrived at by the end of Phase II. National institutions were now formally involved in the activities through their participation in the Technical Advisory Committee. It is not an understatement to say that animal research in Guyana has at its core, the MPSP activities and from these other activities have evolved.

The diagnosis studies conducted in the Coastal area are by far the most complete and important for the country. However, it is important to notice that the data which has been obtained has not been thoroughly analyzed to make the most out of it, specially if one wants to identify the different recommendations domains that may exist.

It is felt by the mission that the characterization studies have provided the project staff with knowledge of the farming situation at the ecological regions

where the project has worked as well as a good knowledge of the handling of the methodology.

The component research conducted related to ecological areas, the heavy acid soils of the Coastal area and the saline soils in the Coast were considered. These are the most important in terms of total land area and concentration of cattle. To address the production problems found in each, different types of experiments to find solutions to specific and general problems were conducted.

Extensive effort to give continuity to the early work on collection and evaluation of grasses and legumes has been done, mainly for the Intermediate Savannahs. It is felt that, considering the total effort of the project in research activities dealing with the management and utilization of the forage resources, the evaluation of germplasm has had an adequate balance.

The area of pasture management and utilization has received the most attention in all phases and reflects the need to be able to propose to the farmer practical manners of handling the forage resources that are available. Different studies have dealt with the establishment of legume grass mixtures, evaluation of pasture management systems, stocking rate trials, utilization of protein banks, and others.

Even though there has been a great deal of effort in the planning and logistics of the execution of grazing experiments at Moblissa and the Coast, there has been less attention paid to the management and interpretation of the data and results.

It is felt by the Evaluation Mission that the type of research that is being conducted in the Coastal area is well oriented and if continued the way it is being done, must provide adequate result to be included in the testing of technology and validation in the future.

Research results appear to have been properly utilized in the design of the alternative systems. It is recommended however, that the coefficients being used in the models be re-evaluated on the basis of results from the current follow up of the involved farms.

Project impacts on the institutional side have allowed CARDI to continuously maintain a group of trained personnel in the area of animal production research around which the national institutions have rallied to develop a national programme for animal research.

On an international level, the project has permitted CARDI to participate in the RISPAL network gaining both, experience and providing research results

that may be used elsewhere, as well as linking the MPSP with other projects within the network.

Methodologically, the systems approach was not always strictly followed but, in an overall sense this has been the methodological approach to doing research at the MPS. There is no doubt that this has proven to be a successful way of going about research for livestock production in Guyana.

On a broader issue, the systems methodology with the modifications necessary to suit the institutional environment has been proven adequate to address animal production systems development and can be used by CARDI or any other institution as their research methodology.

The reinforcement of the Animal Production activities has resulted in an opportunity for CARDI to project its action to Africa by means of the former and actual Project Leaders be granted a leave of absence to collaborate in the implementation of the methodology of system approach in animal production.

Perhaps the greatest single impact of the MPSP to Guyana's livestock sector to date, has been the training of Guyanese personnel in many aspects of livestock research. Training of CARDI, NARI and Ministry of Agriculture personnel by the project in either post graduate studies or practical training by being involved in project activities, has resulted in the formation of a group of professionals currently working in project activities or related livestock research.

It is expected that this core of people will continue to play a role in the development of Guyana's livestock sector, be it in the field of research, extension and policy orientation.

Having analyzed the existing information on the project activities, the ecological and physical conditions of the different working areas, and the results of the interviews with the authorities of the national and regional institutions agree on the following recommendations:

- A very dedicated effort has to be made in order to extensively review what has been done and thoroughly discuss research results.

- A great deal of information on farmer characterization has been collected, however the analysis of this information does not appear to be as complete as the effort expended in this activity would warrant.

- Modelling has, for the most part been limited to reproduce prevailing conditions at the farms being monitored by project personnel. The computer model designed for this should be designed in such a way

that it be possible to identify the critical parameters via simulation and sensitivity analysis.The above requires that the computer model be expanded to include the technical coefficients of the different enterprises that comprise the cost categories included in the financial analysis section of the current model.

- Since the information that is being collected has been regarded as incomplete in some aspects, according to different sources, a very detailed chronogram and type of information being obtained must be set.

- It is suggested that the alternative models being tested be used by project staff to be confronted with technical staff from NDDP working at the regional level.

- During this consultancy a quick ex-ante evaluation of benefits was attempted; unfortunately there was no data available at the project site in order to do, at least this preliminary analysis. It is recommended that measures be taken to assemble this information.

- During the life of the project a number of methodological issues have arised, the project has dealt with some of them but still many remain unresolved; it is suggested that the most important methodological issues be identified and their importance for animal production systems research be assessed.

Because animal production is important to the Guyanese and Regional economies on-farm research must be complemented with experimental research station. It is therefore recommended that Guyana look closely to the establishment and implementation of a central livestock research centre.

The implementation of such an experimental research centre should be considered within the context of a National Animal Production Research Programme, with strong linkages to existing regional livestock programmes. An effort must be carried out for the identification of funds from donor agencies or multilateral financial institutions to achieve this objective.

Stocking rate and other animal production experiments can be very expensive so every effort should done to have adequate design and the experiment well chosen so data obtained is reliable and can be related to the practical situation occurring under farm conditions.

- Research activities have been an important component in the MPS project and should continue having a relevant place among total activities within any actions to improve milk production in Guyana.

- If the systems approach methodology is to be followed, technology transfer must be on the basis of the models that are currently being tested especially the St. Stanislaus College farm for the rotational grazing system, and the Arya Pratinidhi Orphanage farm for the modified cut-and-carry system. The project should make every effort to maintain these model farms going on properly so that they can be used in the future for training not only technical personnel but also farmers and government technicians or students.

Conditions for animal production research in Guyana are far from optimal, distances and accessibility to trial sites, particularly in the Coast, constitute a serious constraint. Access to farmer's fields not located immediately along the road is also difficult during the rainy season; at that time, the dams which can be used during the dry season to reach the farms become muddy and unpassable. Lack of laboratory facilities, spare parts for equipment, chemicals, veterinary products, and above all the lack of a continuous supply of electricity, conspire against the researchers and completion of trials.

Under these conditions, the sole fact that results were obtained in a rigorous scientific way, constitute a project achievement and an effort on the part of the project personnel which must be recognized.

INTRODUCTION

As the Milk Production Systems Project (Guyana) was entered the last third of Phase III, it has been agreed by IDRC and CARDI to have a formal external evaluation to assess the actual project impact and possibilities for dairy industry in Guyana.

To perform this assessment, an Evaluation Mission travelled to Guyana during June 16 - July 6, 1991 to visit the project sites and review all pertinent information on the project.

The objectives of the mission were:

a. to learn and evaluate the technical accomplishments of the project during its execution period.

b. to provide recommendations to CARDI on the future work in Animal Production Research in Guyana and its projections to CARICOM countries.

c. to make recommendations in terms of the type of support needed and to identify some sources that may provide the necessary financial resources.

d. to learn about the institutional achievements obtained throughout the actions of the project.

For the development of the mission the IDRC set the following terms of references to the consultants:

a. To make an indepth review of the work that the project has conducted in the following activities:

   i. Diagnosis and characterization of the production systems.

   ii. Research on the components of the production system, by discipline and ecological area.

   iii. Model and modeling activities leading to field activities dealing with model testing.

   iv. Evaluate the physical, ecological and socio-economical conditions where the activities have been conducted in order to identify constraints and possibilities of future activities.

b. To evaluate the proposed objectives of the three project phases, the degree of achievements and the quality of the information obtained.

c. To make general and specific recommendations to IDRC, CARDI and the national institutions of future orientation of dairy production research and development in Guyana and their possible extrapolation to other CARICOM countries.

d. The final report must consider different aspects that may permit:

   i. IDRC to learn how the project in its successive phases has been able to start a research programme in the country, set adequate objectives and accomplish them, and has allowed for the identification of institutional constraints.

   ii. CARDI to learn how the project has allowed a reinforcement of the institutional capacity for action, to establish long term research activities, and to reinforce its capacity for outreach to other institutions, and other CARICOM countries.

   iii. CARDI, donors and national institutions to learn of the milk production and marketing possibilities in Guyana and how the project may contribute in those aspects.

The report that follows is outlined in four chapters presenting the evaluation strategy; the framework of the project, considering the national and regional aspects; the results of the evaluation and the recommendations from the evaluation results as they apply to the national, regional and donors level. An executive summary is included and various appendices with additional information to that contained in the report.

2. EVALUATION STRATEGY

The mission used the first day in the Caribbean to define its own strategy for operation which was latter communicated to the Project Leader. In Figure 1 is presented a Graphic description of this strategy. This consisted of:

2.1 Review of available information

The main source of information were the project proposals and annual progress reports, the country and regional reports addressing the issues of milk production, the institutional reports of CARDI, NARI, LIDCO, and other information including a thesis done under the project's sponsorship.

2.1.1 List of information reviewed appears in Appendix I. The objective in reviewing them was to become well acquainted of the scope in which the CARDI/IDRC Milk Production Systems (Guyana) Project (MPS-Guyana) was inserted.

2.2.2 Country – in general – and Coastal Region characteristics were obtained from various of the reviewed literature including The National Livestock Research Programme (1988-91). The Proposals for establishing the Dairy Production System (1982), and Annual Reports of the National Agriculture Research Institute (1985 through 1989) among others.

2.2.3 The various CARDI/IDRC Milk Production Systems (Guyana) Project Reports were intensively reviewed and confronted to evaluate the accomplishment and relevance of research and field work done under the scope of the project.

2.2.4 Consultancy Reports served to get acquainted of different external points of view and modifications adopted by the Project according to the recommendation of Consultancy Reports.

2.2.5 Livestock Development Company (LIDCO) Performance Reports (1986 through 1989) helped for obtaining information of large operations as far as animal behaviour and performance is conceived, and for visualizing the inter-relationship between both components, LIDCO and the Project. In this respect, the evaluation team wanted to know the type of results obtained by the Project that were adopted or adapted for using at LIDCO's farms, especially at Moblissa.

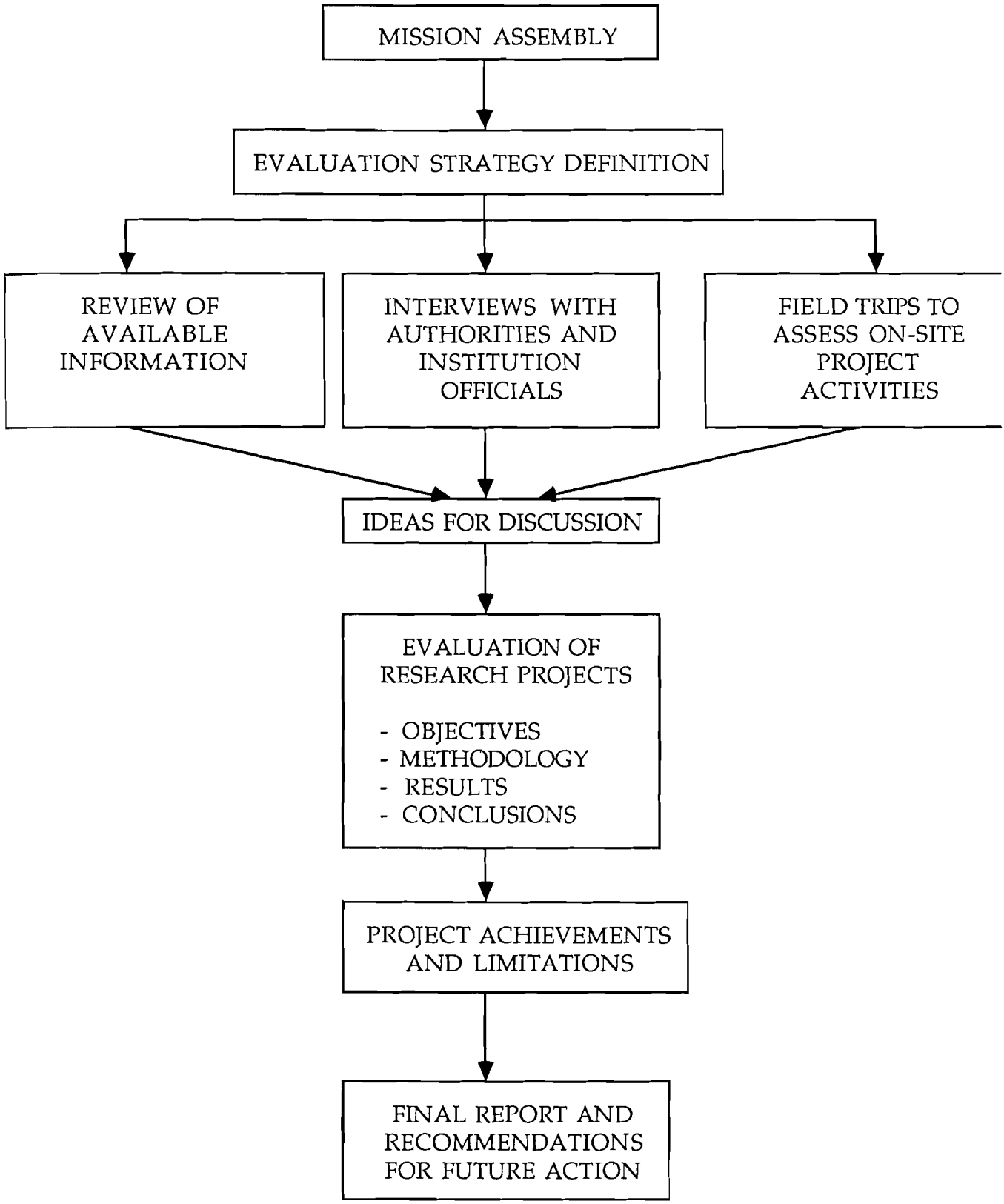

Figure 1 Activities of the Mission for the Evaluation of Project Activities

2.2.6 CARICOM publications (1989, 1991) as well as CARDI's Annual Reports (1980, 83/84, 86/87 and 87/88) and CARDI's Strategic Plan (1988) helped to visualize the needs at Regional and at country level regarding agricultural research and development needs. They also helped to identify objectives and actions taken to accomplish goals.

2.2 Meetings with Authorities and Institution Officials

The list of persons interviewed is presented in Appendix 2. The objective of meetings were for the mission members to learn about the institutional knowledge of the project activities and accomplishments as well as to get some feedback on future activities dealing with milk production in the country and the region.

2.3 Field Trips

These were done to have an overview of the location and facilities where component research was being carried out, and of the farms where alternate Model testing is in progress (Appendix 3).

2.4 Internal Discussions

It was agreed upon that the mission report ought to reflect a concensus view, to the point where this was possible. In order to accomplish this, daily discussions were scheduled and provided the opportunity for exchange of ideas and clarification of specific issues.

3 FRAMEWORK FOR THE PROJECT ACTIVITIES

3.1 The National Framework

3.1.1 General Features of Guyana

Guyana, with a total land area of 214,970 km^2, is by far the largest of the Caribbean Community states. Situated on the north-east coast of South America between 1^0 and 9^0 N and 57^0 and 61^0 W, it is bounded by the Atlantic Ocean on the North, Suriname on the East, Brazil on the Southwest and Venezuela on the West .

Estimations report that around 75 per cent of the land area is covered by rain forest, around 10 per cent corresponds to the savannahs, a lesser percentage is occupied by waterways, (8 per cent) leaving grossly little over 1 per cent for the so called crop land. In addition, there would be around 5 per cent of the total area classified as other unoccupied land (IDB, 1988-89).

Guyana lies south of the hurricane belt and is fanned by the breezes of the Trade Winds. These maintain an average temperature of around 80^oF (27^oC) throughout the year. Guyana's weather is bimodal, tropical and humid with four seasons. Average rainfall in the coastal area is 2,300 mm distributed in two wet seasons clearly identifiable, one being the long wet season being placed from May to August, and the short wet season taking place from November to January. Thus two dry seasons occur in between the two wet seasons.

Administratively Guyana is divided into 11 Regions, of which six of them are located on the coast where around 90 per cent of the total population lives. Therefore, the area in which efforts to develop agricultural production will have the greatest socio-economical impact is by far the Coastal area. Main crops in this area are sugar cane and rice both making up the major agriculture activities of the country. Livestock production for providing meat and milk for local consumption makes for another important activity for the country's economy. Extraction activities, such as forestry and fishery are not as yet established at full capacity in relation to their potential.

Guyana's major economic activities are bauxite products, sugar, rice, gold and rum. Estimations as of 1988 for total exports which amount to EC$608,000,000* included bauxite, aluminium, sugar, rice, timber, rum and shrimp as the main export goods. Values for total imports amounting to EC$586,900,000 corresponding to fuels and lubricants, foodstuff, building materials, machinery and transport equipment and manufactured goods were given for 1988. Main destinations of exports good included, for 1986, countries such as the United Kingdom, United States of America, Canada, West Germany and Japan. The UK and USA accounted for more than 50 per cent of the total exports. On the other

* 1US$ = 2.6 EC$

hand, countries where imports were originated for the same year 1986 included USA, Venezuela, UK, Trinidad and Tobago and Japan, the first three providing around 50 per cent of the total imports.

At the end of 1987, Guyana's external payment arrears reached US$1.1 billion, almost four and one-half exports and thrice GDP. With limited resources, and recent experience of economic and financial imbalance, Guyana has begun a strict economic recovery programme the highlights of which included austere fiscal policies and elimination of the distortions in the exchange rate policies. Limited application of these measures at first was not successful in reverting the decline in GDP which fell by 3.1 per cent in 1988 and again by 5.6 per cent in 1989[1]. As a result, further measures to liberalize the economy have been put in place, tightening government spending and freeing the exchange rate.

While these measures, put into operation at the beginning of 1990 appear to be working in the desired direction, the impact on the poorer strata of the population has been largely negative (real salaries have substantially declined while CPI has risen substantially). As a result, a Social Impact Amelioration Programme (SIMAP) has been recently initiated and expectations of its success are high.

3.1.2 The Agricultural and Livestock Sectors in Guyana

Agricultural activities are concentrated in the coastal areas of the country. They represent the largest productive sector, generating some 25 per cent of the total GDP, over 50 per cent of all foreign exchange and providing employment to slightly more of 100,000 people (37.5 per cent of the national work force).

Some 80 per cent of all cultivated areas is covered by sugar and rice crops. In spite of the importance of these two main activities for the country's economy their production during the last years has decreased. While sugar production was around 300,000 tons for 1981 and 1982 less than 250,000 tons were produced in 1987. The highest production for rice was obtained in 1984 totaling some 190,000 tons while figures for 1987 show production of less than 150,000 tons. The general cause for this situation are higher costs of inputs and lower international prices coupled with post management and macroeconomic distortions which makes rice producers more reluctant to increase their investments in this latter activity.

Agriculture provides for the bulk of the domestic food supply and is the second source of foreign exchange earnings. Whereas sugar and rice provide about 60 per cent of agricultural GDP, livestock activities provide only about 6 per cent, however some 85 per cent of the sugar crop is exported and rice constitute

[1] Interamerican Development Bank. Progreso Económico y Social en América Latina, Informe 1990. Oct 1990.

another important export product. Therefore, livestock production is not only important in terms of domestic food supply but as a potential earner of foreign exchange. This puts livestock production on a challenging situation where productive efficiency should be manifested to overcome the situation. In this respect some of the land occupied with rice crop may be transferred to pasture and livestock production. In fact there is an apparent interest of some producers to get involved into the livestock business, especially in dairy by which they can obtain monthly incomes thus facilitating their cash flow.

Agricultural sector policy is imbedded in the general context of the country's macroeconomic policy. Strategic and limited investments to revitalize the sugar and rice industries coupled with the elimination of distortions and privatisation schemes for GUYSUCO, LIDCO and the rice mills are foremost on the current policy agenda.

At the same time, the Government of Guyana recognizes the need to cut down on food imports and substitute with local production many of the imported goods; as such, milk production increases are of paramount importance within this new policy framework.

Of importance to the project, the following policies are to be implemented; elimination of price boards; elimination of export duties and streamline of the process for export permits, restructuring of GAIBANK, in particular as it refers to guarantee requirements; and the preparation of a five year agricultural research and technology transfer program, including the implementation of institutional framework, required and the increased collaboration with the IARC's.

More and more, the policy scenario appears favourable to the activities of the project, increasing the potential benefits and removing some of the macro constraints.

As far as milk production is concerned, this is carried out mainly in the Coastal area from the Pomeroon to the Corentyne rivers, thus including Regions 2 through 6. In this area a very high percentage of the 250,000 head which comprise Guyana's cattle population is located.

According to estimations some 40,000 cows are milked yearly each of them producing around 800 litres per lactation. The total cow population amounts to some 97,000 thus giving a rough figure that about 41 per cent of the existing cows are milked.

Table 3.1 shows figures representing changes in cattle population in Regions 2 through 6. It can be seen that the Region with the greater increase is Region 5. In this Region the best conditions for milk production are apparent. In spite that it has been programmed to be developed towards rice and sugar production, due to

better expectation with livestock a significant 46 per cent increase in cattle population has been observed between 1985 and 1988.

Average milk production per cow-year in Region 5, appears to be less than for Regions 3 and 4, where 1249 and 1060 per cow-year are produced (Table 3.2). Genetic potential of milking cows and management practices may be playing an important role in this particular case. Taking this into account, the potential of this Region is apparent and all efforts regarding both genetic potential and management practices for cattle behaviour may yield important results which will benefit this component of the agricultural and livestock sector. In addition this Region has an important percentage of the total pasture land available in the Regions considered (Table 3.3).

Table 3.1 Cattle Population in Regions 2 - 6 for 1985 and 1988.

Region	1985	1988	% increase
2	10,400	13,006	25.1
3	28,800	35,926	24.7
4	11,500	14,386	25.1
5	52,900	77,082	45.7
6	90,300	102,066	13.0
Total	193,300	242,466	25.4

Source: Ministry of Agriculture

Table 3.2 Estimation of milk yield per cow in the Various Regions for 1988

	Estimated annual milk production (lts x 1,000)	Estimated number of milking cows	Yearly yield per lactating cows (lts)
2	1,648.8	2,012	819
3	6,324.7	5,062	1,249
4	2,555.6	2,411	1,060
5	10,055.2	12,219	822
6	7,309.8	18,069	404
	27,894.1	39,773	701

Source: Evaluation mission, 1991.

Table 3.3 Available Pasture Land by Region

Region	Hectares	%
2	2,683	4.78
3	4,363	7.78
4	5,799	10.34
5	20,976	37.40
6	22,271	39.70
Total	56,092	100.00

Source: IDB, 1988 (Emona Inzeniring Study)

Regarding cattle breeds and crosses the upgrading of local creole cattle with Holstein would be preferred for improving milk productivity. The use of Zebu and Holstein cattle presents serious limitations as far as milk production is concerned. The former will let less available milk for sale due to the use of the calf for milk let down, while the latter is quite susceptible to various diseases occurring in the tropics.

With respect to type of dairy operations defined for Guyana the MPS Project has identified two basic models, model A (cut-and-carry) and model B (rotational grazing). Figure 2 shows their current characteristics.

Satisfactory results have been obtained with the cut and carry system when it is based on improved pastures. Some problems may be found on the use of supplemental feed and this being due to availability to the farmers. Not much care is apparently taken in relation to animal nutrient requirements as far as they can get some forage to consume. Thus this would be part of the future work to be considered if developing of this sector is to be continued.

Others features which can be mentioned in relation to practical Models A and B are related to calf rearing and cow milking. In this respect mechanical milking is rare and apparently the only small farms using mechanized milking are those related to CARDI's project. The practice of milking the cows with the calf upstand is quite generalized especially with creole breeds having a high percentage of Zebu blood. By this practice, not much attention is paid to the calf's satisfaction of daily requirements thus getting variable rate of weight gain during the rearing period.

Table 3.4 gives rough estimates related to animal growth up to first calving. Apparently growth rate decreases while animals get up to maturity. Both mating and calving weights are unsatisfactorily low thus causing some reproductive problems and ulterior low milk production.

Figure 2 Characteristics of Dairy Operations

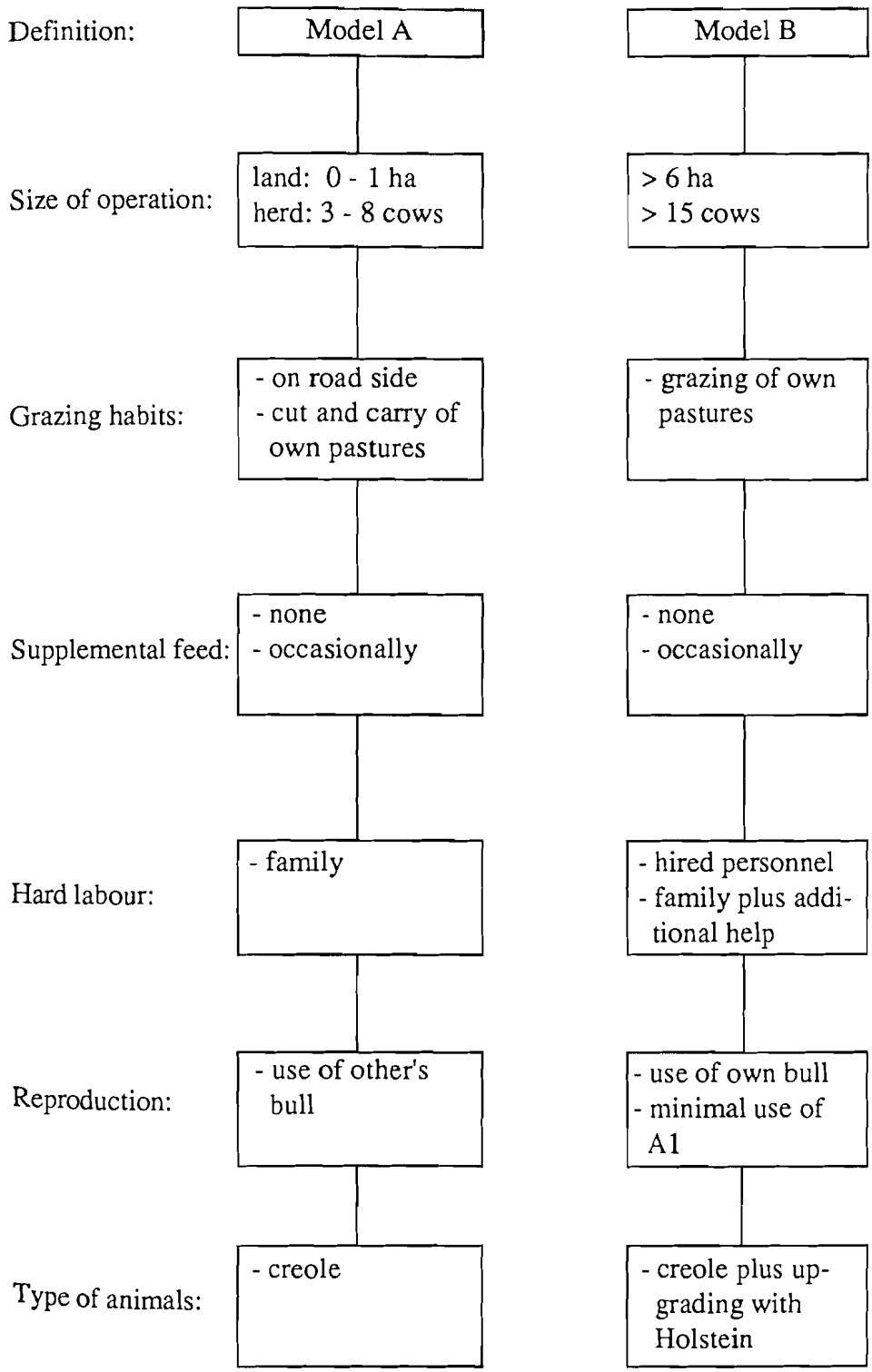

Table 3.4 Estimates of Animal Average Growth Characteristics

Birth weight (kg)	30	
Weaning weight (kg)	60	
Weaning age (days)	80 - 130	3.5 months
Ave daily weight gain in the period (kg)	0.285	
Mating weight (kg)	260 - 280	
Mating age (days)	900 - 940	2.5 years
Ave. daily weight gain in the period (kg)	0.135	
Calving weight (kg)	300 - 320	
Calving age (days)	1350 - 1400	3.8 years
Ave. daily weight gain in the period (kg)	0.088	

Source: Evaluation Mission, 1991.

3.1.3 Dairy Sector Policies

On the policy side, the Guyanese government has pursued, in principle an overt policy of favouring milk production; the Moblissa Dairy Unit, the creation of NDDP, the involvement of LIDCO in milk production and marketing, and GUYSUCO's Versailles Milk Complex attest to this effort.

The recent economic constraints faced by the government have however resulted in dairy sector development becoming a secondary concern of these government owned enterprises whose primary mandate was elsewhere.

On the other hand, in spite of government being involved extensively in the livestock and dairy subsectors, there is no real cohesive dairy policy nor an institutionalized mechanism for coordination between the major institutions involved in dairying.

The 1987 - 1990 Agricultural Sector Plan aimed among other things to achieve a rapid increase in aggregate output and productivity in the overall agricultural sector. Within the livestock and dairy subsectors, major emphasis was to be placed on the improvement and expansion of milk production.

To that effect, the instruments proposed clearly reflected the Government of Guyana's intention of turning milk production into a profitable activity for farmers to get involved in. However, due to unforeseen circumstances, the application of those instruments has not been possible to the desired level.

Thus, milk production continues to be insufficient to meet demand, donated imports continue to be sold at lower than world market prices and therefore discourage local production, milk collection by GMP has been discontinued, and there appears to have been a substantial drop in marketed production.

Although local production has shown continuous growth since the early eighties, imports (in particular EEC skimmed powder milk and butter oil) continue to play an important role in the country's domestic milk supply (about 10 per cent in 1989[2]) and, primarily in the urban markets, for whom the fluid milk equivalents of imported powdered milk consumed are larger than the output of the one fluid milk plant in Guyana.

On the positive side, Guyana has laid the institutional foundations to ensure a sustainable and adequate growth of the dairy sector, through the creation of specialized institutions (such as the NDDP established in 1984), and the strengthening of the dairy aspects of the Livestock Development Company LIDCO. While at this time, these may not be operating as planned due to the overall economic situation, no substantial institutional policy changes are required in order to promote the growth of the dairy subsector.

3.1.4 Agricultural Research in Guyana

The research dealing with animal production began in the 1970's when forage introduction studies were done in the Intermediate Savannahs. Work was continued in the late 1970's with some collaboration from the University of Florida and evaluation of grasses and legumes was done at Moblissa and Ebini. Continuation of this work with studies on the establishment of forage species in the Intermediate Savannahs and some commercial planting of Antelope grass (*Echinochloa pyramidalis)* was done at the LIDCO's Kabawer Ranch.

The research involving animal measurements was not established until the Milk Production System Project started activities in 1982. Later, in 1988, the activities of the MPSP led to the proposal of a National Programme for Animal Production which is to provide the basis for the work on animal production research to be conducted in the country. Some of the features of the Programme are the following:

a. National research activities must be continued in order that Guyana may play its role at the national and regional level. This considers the potential

[2] Agrilatte Sistemi, Guyana Dairy Study, 1990

for contributing to food self-sufficiency and food security; the potential for effecting import substitution and contribute to foreign exchange savings; the prospects for expansion of employment, income generation and rural development; and in the case of ruminants, the possibilities for economic utilization of abundant marginal lands.

b. The proposal considers production trends of beef, milk, poultry meat, and pork, and the production of sheep and goats, the national and regional needs for these commodities.

c. The research programme is aimed at developing technologies that may facilitate an increase in production and an improvement of the productivity of the various subsectors found in the livestock industry.

d. The role of CARDI and NARI has been defined considering the institutional leadership in each sub-programme which addresses the different species and the component of the production system. However, CARDI has been designated as the lead institution in undertaking the National Livestock Research Programme.

3.2 Regional Framework

3.2.1 The Caribbean Community Agricultural Development

Within the general context of the world economy which promotes liberalization of the economies and trade, while at the same time the strengthening of economic blocks which seek to gain competitive advantages would seem to negate the first premise, the CARICOM region faces a serious challenge for the nineties. Notwithstanding the economic crisis that has affected all the countries in the region, the unequal distribution of resources, both natural and human constitute a barrier for regional development.

Trade deficits are high, particularly as refers to food and food items, and as such, need to be addressed as one of the possible areas where intra regional trade and cooperation will yield the most benefits.

The main goal of the rationalization of agriculture within the Caribbean Community is to significantly increase and improve the level of production, productivity, and profitability of agricultural enterprises; to provide increasing levels and a better distribution of real per capita income for the Region's producers and traders; and to increase the flow of high-quality competitively priced food and non-food commodities to regional consumers, the tourist trade and to extra-regional markets.

To accomplish the above mentioned goal, needs have been identified and integrated into a regional development plan for agricultural integration in the

CARICOM for optimum utilization of agricultural resources, improvement of agricultural production efficiency, increase in the standard of living and income of rural population and expansion of agricultural production for export within and outside the Caribbean Common Market, among others. In addition:

(a) levels of regional food and market security for consumers, producers and traders should be increased;

(b) production and markets should be diversified;

(c) adequate linkages within the agricultural sector and between this and other sectors will have to be promoted;

(d) productivity of the human, physical and financial resources used in agriculture should be enhanced through provision of greater incentives for labour, development and extension of more appropriate farming systems, improved management and conservation of natural resources, and through the development of appropriate policies and programmes to encourage the orderly and effective inventory of the Region's resources, as well as to ensure the close monitoring of their uses;

(e) higher technological levels should be achieved through greater orientation and rationalization of research and development programmes and through improved conditions for technology acquisition and adaptation from outside and within the Region;

(f) utilization and distribution of resources in agriculture so as to facilitate the expansion of commercially viable enterprises should be increased and improved;

(g) inflow of resources into the sector and reversal of the trend in current outflows should be improved through provision of appropriate incentives, both to stimulate private inflow and halt private outflows from the sector, through the greater allocations from the public sector, improvement of rural amenities and infrastructure, creation of employment, generating activities in rural areas and through the removal of obstacles to intra-regional capital mobility; and

(h) an enhanced awareness that resources should be used in a way which preserves environmental and ecological balance and stability is needed, so that the Region's responsibility to promote the objective of a sustainable development will be attained.

3.2.2 The Caribbean Agricultural Research and Development Institute (CARDI)

In 1975, the Governments of the Caribbean Community established CARDI as an autonomous organization to succeed the Regional Research Centre in the Faculty of Agriculture of the University of the West Indies.

As such, CARDI has been designated by the Standing Committee of Ministers of Agriculture of the Caribbean Community as the administrative agency for the Caribbean Agricultural Research Co-ordinating Committee. It also serves as the regional branch office of the Technical Centre for Agricultural and Rural Co-operation, an international agency specializing in technical information transfer.

CARDI's main objectives are:

1) To provide for the research and development needs of the region as identified in national plans and policies.

2) To provide and extend the application of new technologies in production, processing, storage and distribution of the agricultural products of member countries.

3) To provide for the coordination and integration of the research and development efforts of member countries where this is possible and feasible.

To achieve these objectives CARDI has staff and facilities in all twelve member countries:

- Antigua and Barbuda
- Barbados
- Belize
- Dominica
- Grenada
- Guyana
- Jamaica
- Montserrat
- St Kitts and Nevis
- St Lucia
- St Vincent and the Grenadines
- Trinidad and Tobago

Most of these countries are small in population and land area. In total there are more than 5,300,000 inhabitants who live in an extension totalling 257,404 km^2. Table 3.5 gives the population and land areas for the countries involved.

Table 3.5 Populations and land area for the twelve member countries comprising CARDI.

Country	Area (km^2)	Population (thousands)	Population Density (person/km^2)
1 Antigua & Barbuda	440	76.30	173
2 Barbados	439	253.50	577
3 Belize	22,962	170.38	7
4 Dominica	751	81.21	108
5 Grenada	344	95.80	278
6 Guyana	214,970	756.00	4
7 Jamaica	10,992	2,335.80	213
8 Montserrat	104	11.90	114
9 St Kitts/Nevis	269	47.00	175
10 St Lucia	616	142.34	231
11 St Vincent & the Grenadines	389	111.00	285
12 Trinidad & Tobago	5,128	1,217.14	237

Data on Table 3.6 summarizes the major economic activities with some data about intra-regional and total imports and exports for the CARDI member countries.

Table 3.6 Major Economic Activities, Intra-Regional Imports and Exports and Total

Imports and Exports of the twelve CARDI Member Countries

Country	Major Economic Activities	Total Exports EC$*	Total Imports EC$	Intra-R Exports EC$	Intra-R Imports EC$
Antigua & Barbuda	Tourism, light assembly goods, and agricultural products	22.1M	656.1M	14.4M	51.2M
Barbados	Tourism, sugar and other agricultural products	471.0M	1,579.9M	2127.8M	219.8M
Belize	Sugar, Citrus, Beef, Timber	210.9M	350.2M	18.6M	15.9M
Dominica	Bananas, Citrus, soap, coconut, and coconut oil	125.1M	165.9M	21.6M	46.4M
Grenada	Nutmeg, mace, cocoa, bananas, onions	58.4M	177.6M	6.6M	39.2M
Guyana	Bauxite prod., sugar, rice, gold, rum	608.0M	586.9M	26.3M	35.4M
Jamaica	Bauxite, Alumina, Sugar, rum, tourism	2,104.3M	3,858.6M	157.8M	150.9M

Country	Major Economic Activities	Total Exports EC$*	Total Imports EC$	Intra-R Exports EC$	Intra-R Imports EC$
Montserrat	Electrical components, tourism, cotton	9.5M	68.2M	0.3M	9.6M
St Kitts/Nevis	Sugar, tourism, assembly of electrical equipment	68.1M	190.4M	6.8M	28.2M
St Lucia	Bananas, tourism, coconut production, electronic equipments	214.7M	483.9M	53.1M	88.4M
St Vincent & The Grenadines	Bananas, coconut, arrowroot, flower, ground provisions	139.8M	254.3M	71.5M	37.1M
Trinidad & Tobago	Petroleum and petroleum products, Amonia, Methanol, urea, natural gases, sugar and manufactured goods	3,797.1M	3,036.0M	456.1M	183.8M

* 1 US$ = EC$2.6

Source: Caribbean Community Secretariat (1989).
Date as of for 1986-1988.

3.2.3 About CARDI's Strategic Plans 1988/1993

In June 1988 CARDI put out a Strategic Plan 1988/93 which prioritizes the various actions to be taken in order to meet its stated objectives.

CARDI's strategy is to identify the agricultural research and development needs of member countries, study the basic research results available from other institutions, undertake applied and adaptive research in a selected range of crops and livestock enterprises to generate new technology, and to transfer it to extension agents and farmers.

Thus, three main Programmes which relate to the Milk Production Systems Project for Guyana are defined. These are: the Animal Production Programme, the Crop Production Programme and the Technology Adaptation and Transfer Programme.

CARDI's Animal Production Programme is aimed at import substitution to reduce the huge food import bill.

In this respect, data on Tables 3.7 and 3.8 gives values on whole milk production and total milk imports for all the CARDI member countries, that will help to corroborate the above statement.

Thus, according to data appearing on Table 3.7, when expressing animal milk production on a per capita basis for all countries (with the exception of St Kitts and Nevis) the average milk production during the 1980-1986 period equals 36.0 lts which is very down the figure suggested by WHO-FAO of 150 lts for an adequate nutrition. Therefore, imports are a must to make milk more available for human consumption in the whole area. Countries particularly depending on imports would be: Belize, Dominica, St Lucia, St Vincent and the Grenadines, and Trinidad and Tobago. These countries have a total of about 1,700,000 people, which roughly represents more than 32 per cent of the total population in the twelve CARICOM countries. In the specific case of Guyana, total milk production per capita falls below the average for the 11 countries considered. However there is an apparent increase in milk production in this country, which according to unofficial sources would amount to over 39 lts per person on a yearly basis. In this sense there would have been a total milk production of about 29,000,000 lts during 1990, thus showing a successful effort in this area of livestock production.

In this particular sense CARDI's Animal Production Programme would have been yielding positive results if the Milk Production System (Guyana) Project really started having an impact on producers as of 1985.

Nevertheless imports of milk and other dairy products seems to maintain a slight but continuous increase (Table 3.8).

Table 3.7 Whole milk production, in metric tons, in CARDI Member Countries

Country	1980	1981	1982	1983	1984	1985	1986	Average	Production per capita
Antigua & Barbuda	13,000	13,000	6,000	6,000	6,000	6,000	6,000	8,000	104.8
Barbados	7,500	7,146	7,041	7,758	8,730	9,331	10,000	8,215	32.4
Belize	279	294	318	442	530	504	---	395	2.3
Dominica	53	54	54	53	59	130	135	77	0.9
Grenada	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	20.9
Guyana	---	14,000	15,040	15,570	17,860	23,030	23,000	18,083	23.9
Jamaica	50,000	51,000	48,175	49,350	39,818	36,575	38,942	44,837	19.2
Montserrat	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	168.1
St Kitts/Nevis	---	---	---	---	---	---	---	---	---
St Lucia	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	7.0
St Vincent & the Grenadines	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	9.0
Trinidad & Tobago	5,730	7,389	8,113	8,122	10,073	10,557	11,325	8,758	7.2
TOTAL	82,562	98,883	90,741	93,295	91,070	92,127	95,402		36.0

Table 3.8 Total imports of milk and cream either fresh, preserved, concentrated or sweetened for CARDI Member Countries during the last five years (EC$ x 10^3)

Country	1980	1981	1985	1986	1987	1988	1989	1990	Ave/yr	Rank order	Input per capita	
Antigua & Barbuda	3,216.7	3,480.7	---	---	5,029.7	---	---	---	3,909.0	9	51.2	8
Barbados	7,652.1	5,391.0	5,199.5	4,354.9	6,393.4	8,534.0	11,245.7	8,712.7	7,185.4	6	28.3	11
Belize	17,771.4	25,323.0	13,524.3	11,122.7	12,321.5	10,548.9	19,647.9	14,920.2	15,647.5	4	91.8	1
Dominica	3,071.1	4,098.8	3,359.9	4,145.8	4,025.2	5,445.5	5,513.6	---	4,237.1	8	52.2	7
Grenada	4,116.8	5,929.9	6,961.1	8,132.3	7,492.8	---	10,350.5	---	6,547.2	7	68.3	3
Guyana	27,215.0	30,732.6	---	---	---	---	---	---	28,973.8	3	38.3	9
Jamaica	26,422.4	37,065.3	24,428.7	26,459.7	31,379.8	27,151.6	72,907.5	46,723.7	36,567.3	2	15.6	2
Montserrat	---	613.2	---	1,062.3	1,045.2	---	---	---	906.9	12	76.2	2
St Kitts/ Nevis	---	3,264.7	2,985.9	2,256.0	1,802.0	3,417.8	3,362.6	---	2,831.5	11	60.2	5
St Lucia	5,257.6	6,603.7	6,486.0	8,353.9	7,289.0	10,250.2	10,359.8	12,210.3	8,351.3	5	58.7	6
St Vincent & the Grenadines	3,354.1	1,928.5	2,147.2	2,115.7	2,756.6	3,037.3	4,668.5	5,347.0	3,169.4	10	28.6	10
Trinidad & Tobago	78,318.8	96,394.4	97,620.6	65,274.8	78,480.9	60,442.9	78,838.3	73,996.5	78,670.9	1	64.6	4
											58.8	

--- data not available

1US$ = 2.6EC$

Lines included in the Animal Production Programme are the following:

1 Forage seed production, development of forages, and the expansion of improved pastures.

2 The utilization of by-products in feeding systems and the development of feed from local ingredients.

3 Improve dairy and beef production systems.

4 The development of more efficient systems for increased production of sheep and goats for meat.

The Milk Production System (Guyana) Project which is the object of the present evaluation has an apparent relationship with the first three mentioned above. It would not have a direct relationship with CARDI's second programme, the Crop Production Programme which includes lines of work on grain legumes, root crops, vegetables, fruits and flowers, although some of the waste derived of these production lines could be used as feed supplements or as a cheap feed source for animals with less nutritive (energy) requirements.

The MPS (Guyana) Project is somewhat related to the Technology Adaptation and Transfer Programme which utilizes improved components of technology, integrating them into systems to increase farm productivity for providing economic stability. The main outputs from this Programme will be (1) the development and effective transfer of technological packages for increased production, (2) the testing and validation of technological packages, (3) the adaptation of production systems in various environmental conditions, (4) the development of integrated crop/livestock systems, (5) the development and utilization of better mechanisms for technology transfer.

4 PROJECT EVALUATION

4.1 General Objective

Considering that the Production Systems methodology is oriented to reach the farmers with "improved" technological options through a programme of transfer of technology, the project followed the approach in the different phases of operation as is presented in Table 4.1. The description of the type of activity to be conducted at each of the steps varied as the project staff gained expertise in managing the systems approach. For instance, at the Design workshop held at the start of Phase I it was proposed to "evaluate technically and economically the systems under farm conditions and estimate their meat and milk production potential". In order to do that, regular visits were made and record of farm activities obtained. The result of the work at the Statal and satellite farms at the Moblissa area was the characterization of the prevailing system and identification of constraints was made. When the project wanted to move to a second phase it was indicated that a proposal of a model was to be developed by the end of this phase. This early decision of proposing the option to be tested, is especially important because at that time an effort was being made within the RISPAL projects to arrive to this stage as early as possible.

From the aforementioned Table 4.1 it can be seen that for the Satellite and Coastal farms the project has moved to the definition and testing of models activity that is presently being conducted, with special emphasis on the coastal area. Thus from the methodological point of view, what has to be done next is to go into the validation and transfer of technology phases.

It does not appear very clear why in the case of the Satellite farms it has taken such a long time to get to the model testing stage. The available information indicates that early in Phase III testing of the model has begun, but it cannot be ascertained how far it has gone. From the last Progress Report it appears that the testing of the rotationally grazing system (Model B) has been abandoned, but no comments on this decision are made.

It is the Mission's opinion that the methodological issues as seen from the point of view of execution of a project and have been raised in the last progress report, is an example of the deep knowledge and common use of the methodology is by project staff members.

In order to have a solution to the above mentioned issues, the project staff should discuss them with the Project Advisor or Consultants to use their experience. Besides, the Secretariat of RISPAL was set up to promote horizontal cooperation among projects dealing with similar methodological issues.

The general objective for Phase I was to demonstrate that the output of livestock products and the net incomes from farmers can be increased by the development

of livestock production systems based primarily on forages and local by-products. This objective was, certainly not possible to attain at that time with the limited knowledge about the production systems and the environmental and ecological conditions in which these systems functioned.

Table 4.1 Utilization of methodological steps of the systems approach to animal production research and development by the MPSP in Guyana

Methodological Step	Geographical Area		
	Moblissa	Satellite Farms	Coastal Area
Characterization of the prevalent system	Phase I Phase II	Phase I Phase II	Phase II
Identification of Constraints	Phase I Phase II	Phase II	Phase II
Proposal of technological options	Phase II	Phase II	Phase II
Definition of models	Phase II	Phase II	Phase II
Testing of Models		Phase III	Phase III
Validation of Models or Technological Options			
Transfer of Technology			

The general objectives of the subsequent two phases reflecting perhaps a certain degree of caution, gained by appreciating the difficulty of the task at hand, appear much more modest in scope:

- To develop improved livestock production systems for the small and statal farms of the intermediate savannahs and coastal areas of Guyana, was the general objective of Phase II, and

- To develop improved livestock production systems for the intermediate savannahs and coastal areas of Guyana was the general objective for Phase III.

However, these objectives appears possible to reach at this stage and has provided the guidance for the three phases of project activity in Guyana.

Therefore, the evaluation of the Milk Production Systems Project in Guyana should consider the initial general objective as the overall objective of the activities undertaken by CARDI and IDRC in the Intermediate Savannahs and the East Coast of Guyana.

4.2 General Appraisal of Objectives

4.2.1 Specific Objectives, Phase I

The specific objectives described for Phase I were:

a. to develop appropriate techniques for the pasture establishment and production of selected forage legumes and grasses.

   Based on CARDI's past experience and on that gained at the University of the West Indies Forage Legume Project, the objective did not seem unrealistic. CARDI had inherited from the Forage Legume Project over 100 grasses and 300 legume "lines", many of which had proven to be of "sufficient promise to be recommended for use in livestock feeding systems[1] ". While establishment of grasses proved not to be a difficult task (however, none of the grasses proposed to try out proved to be better than the already established *Brachiaria humidicola*), establishment of grass/legume pastures was not an easy task as one would have gathered from the above objective.

b. To devise grazing management (systems of grazing, stocking, etc.) and fertilizer requirements for effectively utilizing selected forage legumes and grass pastures.

   This was a valid objective in the sense that it was the logical step from objective (a). However, in the case of fertilization no connection was made to the difficulties in obtaining adequate amounts of fertilizers in Guyana at the time, and the high fertilization requirements suspected for the Intermediate Savannah soils.

c. To select, and refine as necessary, forage conservation practices to supplement feed supplies during the dry season and other periods of stress.

   Based on previous knowledge this was a reasonable objective. However it has proven very difficult to transfer the findings and technology developed in this area.

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[1] Caribbean Agricultural Research and Development Institute: Development of Forage-based Systems for Meat and Milk Production in the Caribbean. Proposal to IDRC March 1980.

d. To incorporate into the production systems presently unused and under used by-products.

Whilst this objective is not clearly stated to indicate which agro-industrial or other agricultural by products, it was clearly an important one given the existing economic situation in Guyana and the difficulties in obtaining continuous supplies of good quality feed.

e. To evaluate, including economic evaluation, these systems under farm conditions and estimate their meat and milk production potential.

Based on the duration of the project and on the little accumulated knowledge about the Intermediate Savannahs this was an unrealistic objective, the best that could be hoped for was an economic evaluation of the different components.

f. To document the findings and make them available to the Region and internationally.

Given the little accumulated knowledge about agriculture in the Intermediate Savannahs, this was a most important objective to be spelled out. This, of course, should be the objective of any project that includes a research component.

On the methodological side, to comply with the required stages of a system's approach to technology generation, a primary objective of the project should have been to identify the problems and constraints to forage based milk production systems in the Intermediate Savannahs of Guyana (Diagnosis). While this is somewhat implicit in the "spelled out" objectives it appeared, to the review team, that the application of the conceptual approach of farming systems research was in, and of itself, an objective of the project.

On the policy scenario, the project objectives somewhat ignored that Guyana's policy for the Intermediate Savannahs was for milk, and not meat production. As such, the project having to date has concentrated only in the milk aspect at Moblissa with little or no direct mention of the applicability of research findings to meat production in the Intermediate Savannahs.

4.2.2 Specific Objectives Phase II

The specific objectives for Phase II reflect the more serious understanding of the true – rather than perceived as in the first phase – limitations and constraints to forage based bovine production systems in the Intermediate Savannahs. At the same time it is recognized that the medium term future of milk production in Guyana lies with the Coastal farmer rather than with the Government

developed Moblissa scheme. In tune with this new focus of the project to look at both milk production areas, the objectives were as follows:

a. To characterize the livestock production systems in the two areas.

   This objective reflects a better conceptual grasp of the "systems approach". While characterization had been done at Moblissa, production systems of the Coastal dairy producer had to be studied and understood to identify constraints and opportunities in order to "fine tune" the research agenda to adequately address problem areas.

b. To select suitable grasses and legume pastures for the Coast.

   Compared to the objectives regarding pasture spelled out for Phase I, this objective appears to be a modest one. Yet, based on the experience at Moblissa this degree of caution as warranted. In fact, as the project developed, and more in tune with the systems approach more emphasis was placed on understanding and improving already existing pastures as stated in the ensuing objectives.

c. To develop appropriate pasture management techniques for both areas.

   This objective encompasses both the research knowledge accumulated during Phase I of the project as well as a basic understanding of where substantial improvements in forage based systems in Guyana could be effected.

d. To design and test improved livestock production systems suited to the LIDCO farm, the Moblissa satellite farms, and the dual purpose farms at the Coast.

   Based on accumulated experience and resources, this was an over ambitious objective. At the same time it tended to ignore the existing problems both at the LIDCO farm and the Moblissa satellite farms which lead to their rapid deterioration as viable enterprises.

e. To train Caribbean technicians in animal production systems.

   The encouraging results of Phase I in this objective warranted the continuation of activities on this line.

4.2.3 Specific Objectives, Phase III

The accumulated component research results and the institutionalization of the systems approach in Guyana's animal production research activities led to the formulation of the following specific objectives for this phase:

a. To evaluate improved livestock production alternatives for the East Coast.

In evaluating the characterization and component research results from the previous phases, alternative systems were proposed. In keeping with the systems approach methodology this objective is foremost.

b. To select suitable grass and legume pastures for both, acid and saline Coastal soils.

While little emphasis was placed on this objective, the possibility of diseases or pests suggest that there is a valid reason to continue research in this area. The inclusion of this objective within a project of this nature may be arguable in the sense that this may be considered the responsibility of a national research institution. On the other hand, it could be argued that this project in the previous phase had become the core – by providing leadership and a force for agglutination more than on the research effort – of Guyana's national research activities on animal production and ignoring this aspect would be a serious omission.

c. To develop appropriate pasture management techniques in the two project locations.

In spite of this being a seemingly recurrent objective it should be recalled that livestock research takes a long time so that, there are still a substantial number of questions to be answered in this respect. Based on the fact that the Milk Production Systems Project initiated the pioneering research in this area, the continuation of activities towards the fulfillment of this objective was warranted.

d. To start a seed multiplication programme for promising pasture grasses and legumes.

On reviewing the available information, this objective appears to crop up suddenly, without explicitly being indicated in any of the project documents that seed availability constituted any kind of limitation or constraint to pasture establishment. Consideration of accessibility by road and costs of transportation involved in establishing pastures using vegetative seed, warranted limited research into this aspect. However, the establishment of a seed multiplication programme appeared to be beyond the scope of the project.

e. To develop an appropriate health calendar for the East Coast.

Having identified the health aspect as a constraint to developing efficient milk production systems this aspect required effort spent on the part of the

project. However, up to date nothing substantive has been done to accomplish this objective.

f. To evaluate present marketing channels for milk and beef and propose alternatives if necessary.

As research progresses to the validation of results, constraints from outside the farm environment begin to gain importance over the purely technical aspects. As such, an evaluation of this nature is obvious within the specific realm of the project.

g. To train Guyanese scientists and technicians in livestock production systems.

This objective centers on the accomplishment of the training component of the previous two phases.

In reviewing the objectives of the three phases from the vantage point of hindsight it can be sensed that these have become progressively more realistic and practical as the involvement of CARDI and IDRC in Guyana has continued. Knowledge gained by project personnel, during each phase, both from component research and practical knowledge have been reflected in the objectives and activities proposed for the subsequent stage. At the same time, refinements in the conceptual approach through continuous participation in the RISPAL network have also helped to shape project goals.

On balance, the objectives for each phase do reflect a continuum from the methodological point of view as well as from the accumulated knowledge gathered from systems characterization and research activities.

4.3 Appraisal of Methodological Issues

The production systems research methodology requires a particular approach to the way of addressing the problems to increase production and productivity. It is first to start from a diagnosis or characterization of the existing situation so that research opportunities can be identified and component research begun.

It is obviously possible to begin certain component research concurrently with the characterization of the system, particularly when specific technical limitations are known. There is a certain validity for the way farmers go about their business and thus is precisely the reason for the characterization.

The above appears to have been ignored both in Phase I and Phase II, at least partially on the forage production system. In both phases (Moblissa and the Coast) farmers were already utilizing particular grass species but had little grasp for the establishment and management of such pastures. The MPSP did not

begin to work on these until late in both phases, after other grass species (including those currently in use) went through the CIAT methodology first. Although both ways of going about component research are not mutually exclusive or sequential they seem to have been taken to be so.

Even if better forages would have been found, the management problem of the farmer with his current forage still remained as a constraint to the system and the systems approach calls for some research to be undertaken in that sense. It turned out that the farmers were utilizing the best forage species available and management research was delayed far beyond what it should have been.

On the other hand, the methodological refinements reached at when confronting the systems approach with the various "real world" situations have been incorporated into the conceptual framework of the project. Research is now more directly linked with system recommendations or system constraints, the concepts involved have been transferred to research in other areas of animal production, and there has been a constant two way flow of information with the RISPAL network.

If methodology is construed to mean the way of doing things, the project has done very well in reviewing the information by holding end-of-year and end-of-phase workshops which were to direct the thrust of research and the direction of the project for the next period. This has proven invaluable in support of the systems approach because it has forced research to be more and more oriented towards the perceived farmers' needs.

This however has caused serious problems in the control of research activities, experiments or activities from one year to another were discontinued or cropped up following no apparent long term vision. In this sense, it would be highly recommendable for the research activities to be tied to a specific problem trying to be solved. It was impossible, for this review team to adequately link together experiments, trials, or lines of action with specific issues which were trying to be solved. Trials on a particular line seem to disappear from one year to the next, only to reappear in a subsequent phase.

Finally, on the issue of methodology it is necessary to emphasize that at each stage of the project a different thrust was required. The project personnel has been able to handle this quite well, either through internal discussions or on the advise of outside consultants, and made the necessary changes to reorient the project activities in the required direction.

4.3.1 First Phase

As mentioned earlier, Phase I objectives do not appear to reflect the systems approach methodology in a clear cut fashion. However, the operative aspects of

the project do, so as the project progressed toward the operative phase the conceptual framework of a systems approach becomes more of a factor.

Thus, the project began operations after a Design Workshop was carried out in April of 1982 and project activities were laid out based on the recommendations of a group of experts knowledgeable of the situation at Moblissa. The workshop attempted to present preliminary diagnostic or characterization information on the existing situation in Guyana's Intermediate Savannahs, more specifically on Moblissa to participants, so that activities to address constraints and further characterization of the production systems could be derived.

Based on the preliminary characterization, a research agenda to address the perceived constraints was devised, as well as an in depth monitoring study to evaluate both, technically and economically the prevailing production systems at the State and small farms at Moblissa.

In general, it can be said that Phase I of the project yielded encouraging results on the technical solutions to agronomic and livestock management constraints. These results were encouraging enough to believe that in a subsequent phase, they could contribute to the design of an economically efficient milk production system for the Intermediate Savannahs.

Viewed from the standpoint of an investment on research as a whole, there were certainly transferable results that would have yielded the project as having positive net benefits. At the same time numerous areas in which continued research was necessary had emerged, and this alone, warranted future investments along those lines.

4.3.2 Phase II Activities

Phase II was initiated on February 1985 and it aimed to capitalize on the knowledge gained in Phase I. At the same time, it was to broaden its scope of attention to the milk farmers in the Coast of Guyana, the region which provided the bulk of milk consumed by the population. It was also evident that conditions for specialized dairies in Moblissa, given the structural problems of the milk market (price controls, competition from cheap imports, etc.) and the continued shortage of inputs, were not adequate. If the project was to impact milk production in Guyana, it was not going to achieve it concentrating its efforts in the Intermediate Savannahs.

The inclusion of a new area required a shift of priorities and the strengthening of the conceptual elements of the systems approach. In the Intermediate Savannahs alternative proposals for certain components of the system were available, on the Coast the situation was different: very little knowledge was available and a characterization to identify the major constraints needed to be carried out prior to initiating the component research activities at full thrust.

In an overall sense Phase II sees the strengthening of the Project in two aspects:

(a) A better understanding and grasp of the methodological issues involved in the production systems approach. This was, in part, due to the refinements in the methodology itself arrived from the shared experiences in RISPAL.

(b) The informal conformation of an animal production research group within Guyana in which the Milk Production Systems Project was to be the nucleous of activity and provide the leadership. This was an important achievement for CARDI.

4.3.3 Phase III Activities

Phase III was initiated in February 1989 after one year extension of the Phase II. Based on the results obtained it was expected that, for the Coastal area, the main thrust would be on the testing and refinements of the alternative models proposed. Research to complete needed information to improve on the recommended systems and "maintenance" research was to be carried out concurrently.

Lines of action for Phase III were established after a workshop, designed to that effect, took place in Georgetown in 1987. The Proceedings of this workshop were lost but the important issues discussed were considered in the project proposal that was approved by IDRC. The emphasis was to be given to Model testing especially in the Coast and some research support was to be conducted at Kabawer, Gold Digging and Moblissa. This phase is still going and has served to start the testing of models and renew several of the methodological issues as has been raised in the Second Annual Report for Phase III.

Phase III consolidates the informal institutional linkages arrived at by the end of Phase II. National institutions such as NDDP, LIDCO, MMA, University of Guyana and the Ministry of Agriculture were now formally involved in the activities through their participation in the Technical Advisory Committee. At the same time, the technical responsibilities for the project were to be coordinated by CARDI with the support of NARI and IICA. The continued presence in Guyana of CARDI, in animal production research mostly through the Milk Production Systems Project, enabled it to establish the institutional linkages and assume the leadership in this area of research thus avoiding unnecessary duplication of efforts.

It is not an understatement to say that animal research in Guyana has at its core, the MPSP activities and from these other activities have evolved.

On the methodological side, there appears to still be a tendency for component research to be perceived as isolated from the systems requirement and standing on its own. Nevertheless research results have become more applicable to the needs of the prevalent production systems and in support of the recommendations for alternative systems proposed.

4.4 Project Sites and Socio-economic Characteristics of Intended Beneficiaries

The project activities have been located in two main locations: the Coastal Area, and the Intermediate Savannahs.

The Coastal Area:

Project diagnosis studies have provided reliable data on farm size, animal numbers and a characterization of the production system for the Coastal Area. During Phase II a diagnosis conducted allowed to differentiate between farms in the Coast from those located along the Abary River. Some of the main characteristics are shown in Table 4.2.

Table 4.2 Characterizations of the Farms at the Coast and Abary River

	Coastal Area	Abary River
Number of Farms Studied	27	6
Farm Size (Ha)	15.50	45.30
Area on Pasture (Ha)	9.75	30.00
Area on Improved Pasture (Ha)	0.50	0.20

Source: Project Reports.

The above data plus project staff member's interpretation indicated that, from the farming system point of view, there are differences between farms in both areas. The Coastal Area farmers, because of location do not have problems for transport and communication and devote the farm to animal production as well as to crop farming, rice production being the most important. However, for a significant number of farmers, tomatoes, green vegetables, coconut, and eschallot production, and the selling of these products, is an important contribution for total income. The general orientation of the farm, in the Coastal Area, is that of a mixed farm where crop production accounts for around 47 per cent of the farm resource, denoting the importance of croping activities.

At the Abary River, the farms are oriented towards cattle production and are larger (average size of farm is 45.3 Ha); very little land is devoted to crop production, used primarily for home consumption in all cases studied. As it has been reported, the comparisons made between the Coastal and Abary River farmers indicate that there are two recommendation domains. Some of the characteristics of the farmers in term of the percentage of occurrence are found in Table 4.3.

Table 4.3 Key Characteristics of Farmers in both Coastal Areas

	Coastal	Abary River
East Indian Ethnic Background	44	83
Nuclear Household	80	100
Use of Family Labour	100	100
Use of Hired Labour	92	100

Source: MPS (Guyana) Project

Although from the data collected the most apparent difference is found in the ethnic background, the information provided by the project reports also indicates that the social setting is quite different between the areas and that it may have an effect on attitudes towards technological change.

The data obtained for both areas indicates that the Abary River farmers are totally dependent on the livestock enterprise and that their farms are typical dual purpose operations: 42,7% of the total income comes from the selling of animals (beef) and 57.3% from milk. These figures are in agreement with what has been found in other tropical areas where dual purpose bovine production systems are utilized.

Because there is more pressure upon the resources and there are fewer number of animals, the coastal area farms receive 61.8% of their income of the cattle enterprise from milk and the rest form the selling of animals.

Based on the data from diagnosis studies conducted in the Coastal and Abary River areas, project personnel, have concluded that most of the local milk supply comes from small producers which have a mixed type of farming operation and produce milk in a dual purpose production system.

Additionally, about 25% of the milk producers do not own any land, so in order to feed the animals they:

- graze the animals on any available land, including roadside and dams.

- cut and carry forage to the animals for evening and night feeding from wherever available.

The latter system called the "cut and carry" is also practiced y farmers who have little land available and is found on about 10 to 20% of the farms producing milk in Guyana.

About 35 - 40% of all milk producing farms fall into the category of small producers, with 5 to 15 ha of pasture. There, the amount of land is not as limiting so they graze their animals in pasture farm land.

The characterization of the milk production system in the Coastal area revealed that besides land, there are other constraints such as:

- feeding and nutrition of the animals

- animal management

- animal health

Fluctuation in weight gain by the animals, associated with low average daily milk production, indicated that animal nutrition was the most limiting factor. The indigenous pastures which predominate in the farms, produce forage of low quality and even in areas under favourable conditions, total production is low, thus permitting only low stocking rates.

b. Intermediate Savannahs

The area covers a large part of the country but has few population centers, with the exception of Linden. Soils are white and brown sands of low fertility. There has been an interest in developing the area through the establishment of dairy units at Moblissa and Ebini, and small satellite farms around the Moblissa Dairy. During Phase I of the project this was the target area for all activities.

The production system at the satellite farms has been characterized into two categories, based on the amount of pasture development and farm size as is presented in Table 4.4.

From these data, it can be seen that even though there are differences in some of the parameters between the categories, the total number of lactating cows is similar. Other important parameters are presented below in Table 4.5.

Table 4.4 Characteristics of Farms in the Moblissa Area

	Category 1	Category 2
Farm size, ha	32.4 ± 11.1	20.2 ± 0.0*
Area on improved pasture, ha	17.6 ± 1.5	5.8 ± 1.1*
Lactating cows, no.	4.8 ± 2.2	4.8 ± 1.5
Stocking rate avg/ha	1.1 ± 0.4	2.8 ± 1.5*

* Parameters where large differences between categories are found.
Source: Project Reports

Table 4.5 Key Parameters, Moblissa Area Farm

	Category 1	Category 2
Milk production, l/cow/day	5.6 ± 2.2	5.9 ± 1.2
Length of lactation, days	277 ± 15	280 ± 0
Total A.U.	19.0 ± 7.0	14.5 ± 4.7

Source: Project Reports

These figures show that production per cow is similar; since the total number of lactating cows is similar also, total production of the farm will also be similar. Due to the influence of the results obtained at Moblissa, the satellite farms use *Brachiaria humidicola* as the improved pasture species; it accounts for more than 90 per cent of improved pastures established. Also the use of pasture rotation has been introduced as well as supplementation, T.B. testing, deticking, and deworming. Twice a day milking is also practised at most farm and no difference among categories was found.

The general economic outcome of the existing system at the satellite farms indicated that there was a need for an alternative system, where some diversification into crop production or intensification of animal production would allow for improvement in the cash flow in the short term. As a consequence, peanuts and tobacco were suggested and profiles of costs and income were made for the proposed alternatives.

The overall situation at the satellite farms in the Moblissa area is that milk production is not an attractive enterprise and some of the farms have already abandoned milk production. The main constraint has been estimated to have been the marketing of milk and need for a cash flow which cannot be received from the farm's milk sub-system.

The interest by farmers to come to the Moblissa area has not been as expected, therefore few people are involved in milk production in the area.

4.5 EVALUATION OF RESULTS

4.5.1 Characterization and Diagnostic Studies

A great deal of effort was spent on characterization of farms and systems particularly in the Coastal area. This effort was combined with a Canadian International Development Agency (CIDA) two year project initiated in 1984[2]. The MPS concentrated its efforts on the farmers along the Coastal road while the CARDI/CIDA did so along the Abary River on the MMA development project.

Both characterizations were made more from a technical point of view than from a multidisciplinary concept of a farm. In that sense, technical limitations to the system were examined and adequately dealt within the alternative systems design. Economic, sociological and other data were not given high priority. In spite of, these characterizations will be of value after a complete analyses has been done when moving into the validation stage. The proposed models may suffer modifications upon adoption due to the high investment costs required (G$381,000 for a model A farm and G$766,000 for a model B farm).

From the characterization data, the proposed models resulted. These were focused mainly on solving technical problems in isolation from the other farm constraints (labour, resources, education, mores and customs, etc.).

The work conducted allowed for the classification of the satellite farms as falling into two categories based on farm size and the amount of pasture development. Here an accomplishment of the project is evident for the recommended pasture species *(Brachiaria humidicola)* is commonly used. The utilization of pasture rotation, supplementation and health measures have been incorporated into the farm practices. These await a more complete economic evaluation.

The diagnosis studies conducted in the Coastal area are by far the most complete and important for the country. Here again, the impact of the methodology as proposed and used in RISPAL can be appraised. The utilization of the rapid rural appraisal (sondeo), the static survey and the dynamic diagnosis have proved valuable in identification of constraints at the farm level. However, it is

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[2] Pilot Project for Increasing Milk Production Among Small Coastal Farmers in Guyana - CARDI/CIDA

important to notice that the data which has been obtained has not been thoroughly analyzed to make the most out of it, specially if one wants to identify the different recommendations domains that may exist.

It is felt by the mission that the characterization studies have provided the project staff with:

(a) have knowledge of the farming situation at the ecological regions where the project has worked

(b) a good knowledge of the handling of the methodology, that needs some refining in terms of analysis and interpretation of the data

The results of these studies when a more indepth analysis is made will be very useful for the Ministry of Agriculture Planning Office to orient development activities dealing with milk production at specific areas or particular communities. In this way the external constraints affecting the production system can be dealt with.

4.5.2 Component Research

Conditions for animal production research in Guyana are far from optimal, distances and accessibility to trial sites, particularly in the Coast, constitute a serious constraint. In the Coast, flooding during the rainy season forces the researchers to move by boat along the canals at Kabawer and Gold Digging in order to reach the experimental fields which are sometimes covered under two feet of water.

Access to farmer's fields not located immediately along the road is also difficult during the rainy season; at that time, the dams which can be used during the dry season to reach the farms become muddy and unpassable.

Lack of laboratory facilities, spare parts for equipment, chemicals, veterinary products, and above all the lack of a continuous supply of electricity, conspire against the researchers and completion of trials. At Moblissa, the lack of any infrastructure outside that of the State Farm is a serious hindrance to the monitoring and record keeping activities. Besides, research has to be planned with great care in order to timely put in place the inputs required for the trials. Should an emergency come up, there is little chance of correcting it immediately

To add to the above difficulties, which have been around since the inception of the project, the lack of properly trained personnel in the beginning created a "project specific constraint" which has been partially resolved since then. However, it still appears that technical personnel assigned to the project is, workwise, over-extended.

Under these conditions, the sole fact that results were obtained in a rigourous scientific way, constitute a project achievement and an effort which must be recognized, on the part of a group of dedicated young professionals working in or in connection with the project.

The component research conducted related to ecological areas, i.e. the Intermediate Savannahs (as represented by Moblissa); the heavy acid soils of the Coastal area; and the saline soils in the Coast. The first two are the most important in terms of total land area and concentration of cattle. To address the production problems found in each different types of experiment to find solutions to specific and general problems were conducted.

The experiments conducted were oriented to the general subjects dealing with the animal production system:

a. Soil characteristics and requirements
b. Germplasm collection and evaluation
c. Soil-plant relationships
d. Pasture management and utilization
e. Forage conservation
f. Cow, heifer, and calf nutrition.

Accomplishments varied according to the ecological zone and the importance assigned to the specific topic at each project phase.

The estimation to date may be defined as follows and includes the opinions of the Mission members for each general area.

a. Soil characteristics and requirements.

   Different kinds of soils have been identified for the Moblissa area and no attempt to extend this work to the Coastal area has been mentioned. However since this area has been under agricultural production more is known about it, thus reducing the need for specific research on this topic. Greenhouse studies to provide a base for field trials were conducted at Moblissa and planned to be done with saline soils, but little information is available to make good utilization of the results.

b. Germplasm collection and evaluation.

   Extensive effort to give continuity to the early work on collection and evaluation of grasses and legumes has been done, mainly for the Intermediate Savannahs. Although, the work using CIAT's methodology

continues at the Coastal acid soils, the problems encountered in the saline soils have resulted in this ecozone being abandoned.

It is felt that, considering the total effort of the project in research activities dealing with the management and utilization of the forage resources, the evaluation of germplasm has had an adequate balance. Promising species of grasses for the coastal area in addition to Antelope grass, have been identified. This is an important achievement for CARDI and NARI, in case any major disease or pest may affect the actual prevalent species.

The evaluation of legume germplasm has been fruitful in terms of selecting a few species which could be multiplied for use in mixture or as protein banks. The latter is to be preferred due to the difficulties that are still encountered on the management of grass-legume mixture under practical farm conditions in the tropical areas. In this aspect the utilization of legume trees as has been suggested in a consultant's report could be of interest, and the introduction of source species should be encouraged.

c. Soil-plant relationships.

The studies dealing with land preparation, plant response to fertility treatment, and others are grouped under this heading. As is to be expected, the acid soils of the Intermediate Savannahs and the Coast are relatively poor and infertile as occurs in other tropical areas of the world. As a consequence, the problem of sustainable animal production systems may depend on the utilization of nutrient input to maintain pasture production. However, many times this is more a problem of economics, and fertilizers are not used because they are available or are too expensive.

From the objectives as stated in Phase I, some of the trials were to assess soil fertility and determine the economic optimum of fertilizer application. This is quite adequate since forage plant response to fertilizer application in the tropics causes a biological response that is way above the economic response. The issue would be to determine the minimum amount of fertilizer needed to ascertain that pasture production and longevity is maintained in economic terms. Although in the recent phases this appears to be the orientation of the research, no clear indication that this would be considered in future planning is mentioned.

Land preparation studies were conducted at the Intermediate Savannahs and some recommendations to reduce the cost of pasture establishment have been made. However, in the coast where the prevalent pasture is the native one, little effort has been done to study this aspect specially in relation to Antelope grass establishment. There is no apparent problems of getting a good establishment of the species under the usual method of planting.

d. Pasture management and utilization.

This is the area that has received the most attention in all phases and reflects the need to be able to propose to the farmer practical manners of handling the forage resources that are available.

The different studies have dealt with the establishment of legume grass mixtures, evaluation of pasture management systems, stocking rate trials, utilization of protein banks, and others. This area of research is a very complex one because of the different interactions that occur due to the dynamics of the pasture system and the effect of the season of the year, the animals, and several others.

At Moblissa, the management studies have gone from the mob grazing trials to animal production experiments involving heifers and milk producing cows. *Brachiaria humidicola* which has been identified and selected as an appropriate species for the area has become the dominant species in the improved pasture of the region. The efforts made to manage forage grass-legume mixtures have not been very successful apart from the introduction of *Desmodium ovalifolium* which ay be able to compete with the grass. There is some work in progress that should provide some results on liveweight gain and botanical composition changes throughout the year and between years.

It is felt that the work done at Moblissa is providing data that will allow recommendations for the State and satellite farms in the areas. The metabolism studies conducted should allow a baseline for the quality of the forage grown under these conditions. It is important to bear in mind that pasture evaluation studies must be conducted for a long enough period of time in order to be able to come out with valid results. In this sense it was found that some of the grazing experiments have been conducted for a relatively short period of time that makes it dangerous to draw conclusions from them. An example is the evaluation the response to grazing by six grasses where a total period of 40 weeks (less than a year) is reported. Although there appears to be differences among species the time length is too short to draw conclusions on the management and survival of species under grazing. Additionally, in the same experiment, the yield of all species decreased with time and also the ground cover indicating that some of the changes may be associated with time of the year, an aspect that was not thoroughly discussed. From the methodological point of view, it was indicated that this was a mob grazing trial, and the percentages of pasture integration at grazing resembles values normally obtained in grazing experiments.

The above comments are intended to bring attention to the fact that even though there has been a great deal of effort in the planning and logistics of the execution of grazing experiments at Moblissa, there has been less attention paid to the management and interpretation of the data and results.

Similar comments can be made on the experiment where milk production from different pastures was attempted to be measured. Here the length of the trial as reported (20 days) and the high levels of dry matter availability before grazing show that the difference among species ought to be found on carrying capacity rather than quality of the forage on offer. This situation has been changing with time and the experience gained in the conduction of grazing trials has served to have better designed experiments at the present time.

At the Coastal area the research is lagging behind because it was only started during the Phase II of the project. Here again, the pasture utilization work is the most important due to the fact that the production systems are based on the utilization of grass, either by hand cutting (cut and carry) or by grazing. The work done included the testing of different species of grass and legumes at the Coastal Experiment Station at Burma, to grazing trials at Kabawer. Here, Antelope grass is the improved species that is well adapted to the existing conditions, recent trials dealing with the subject of pasture establishment ought to provide a solution to the problem of time and cost involved in the establishment.

It is felt by the Evaluation Mission that the type of research that is being conducted in the Coastal area is well oriented and if continued the way it is being done, must provide adequate result to be included in the testing of technology and validation in the future.

e. Forage conservation.

The line of forage conservation has received attention through studies on methods of grass drying and silage making at both ecological zones. Some of the results obtained on grass drying indicate that the technique of using the solar cages and air current dryers provides in a short period of time a product which can be useful to the farmer. However, the practical utilization of the method has not been pursued further, thus indicating the need for research on the applicability of the method to really be of use under farm conditions.

A similar situation exists for silage making for the dry periods, where the conservation of the excess growth during the long rainy season may result in more forage availability than needed. As has happened in other tropical areas, the main constraint may be the machinery needed to chop the forage so a good quality silage may be obtained. The conservation of forages is

largely a cost-benefit relationship. If the cost is too high the small producer will hardly be willing to spend money in maintaining a nutritional balance in the herd. He will probably sacrifice the dry herd and growing heifers while trying to provide producing cows with enough quality feed. The effect of adequate nutrition of the herd can only be measured in the long run and the use and management of physical models (St Stanislaus and Orphanage farms) can provide the elements to observe the results in terms of improved reproduction efficiency and other herd parameters.

f. Cow, Heifers and Calf Nutrition and Management

Through the three phases of the MPS Project various studies have been carried out which have somewhat contributed to a better understanding of the animal behaviour in response to nutritional and managerial variations.

As a general result to these studies some managerial alternatives have been put out which may aid farmers to adapt themselves and their operations to eventual constraints or changes in the prevailing system.

However productive potential of animals and other non-quantified external factors have produced, in some cases, rather unexplainable results which may have delayed adoptions of the new findings.

As a whole these studies have meant a real need for completion of the proposed goals at the various phases of the project.

Some of the aspects lacking which have somewhat delayed reaching to an established production methodology have been mainly due to external factors to the MPS Project.

4.5.3 Modeling activities

Research results appear to have been properly utilized in the design of the alternate system. Tables 4.6 and 4.7 indicate how the recommendations on system components were arrived at. As can be seen from these two tables, most work on pastures silage feeding, and calf rearing has been a useful input into the alternative system recommendations.

The two tables also show that there are recommendations which lack research support, mainly those dealing with the technical coefficients applied to the model. It is recommended that these coefficients be re-evaluated on the basis of results from the current follow up of the involved farms.

Aside from the issue of apparently over optimistic technical coefficients already brought up, the following issues must be considered in order to improve on the model presented for simulation.

Table 4.6 Recommendations for different components of the modified cut and carry system.

Parameters	Recommendation supported by project research	Comments
A. FORAGE		
(i) Production - Establishment of *Echinochloa pyramidalis* as pasture of choice. *B radicans* can also be used.	Yes	Management and pasture establishment work need further refinements
(ii) Carrying Capacity - One hectare to carry approximately 5 AU; daily dry matter requirements 2.5% body weight.	Yes	Carrying capacity of pasture estimated at 6.0 AU for cut forage. The dry matter allowance should be increased to 2.8 - 3.0% BW.
(iii) Fertilization - Recommend 200 Kg N/ha and 175 Kg P_2O_5/ha split over 4 - 6 applications.	Yes	Only token dressings have been used to date, recommended levels have not been applied yet.
(iv) Harvesting - To be done in the evening for morning feeding and in the morning for afternoon feeding.	No	Practical observation.
(v) Conservation - 0.2 ha to be set aside for growing Penisetum purpureum (elephant grass) for silage making. - To be fed during dry season	No	Only one of the model farms is currently doing this.
(vi) Feeding - "As is" results in 10 - 15 % wastage, chopping is recommended to reduce waste and increase intake.	No	Practical observation.
- Stanchioning preferred; two to four feet through space per cow.	No	Established knowledge.

Table 4.6 cont'd

Parameters	Recommendation supported by project research	Comments
B SUPPLEMENTAL FEEDING		
- Rice bran, copra meal, wheat middlings or a combination of these is intended.	Yes No	No clear cut results available, research continues.
- Assist in bridging dry spells, or to "challenge" the lactating cow; not as a substitute for grass.	No	Based on existing knowledge, ARC tables.
- Provide 14 - 16% crude protein, fed at 2 - 6 lbs/animal.	No	
- Upper limit of dry matter supplied by feed concentrate not more than .5% of body weight.		Based on general management recommendation.
C. ANIMALS		
- Upgrade and select for a phenotype which can fully exploit favourable conditions for milk production.	No	Existing knowledge for animal improvement.
- Bulls to be kept by farmers and replaced every three years.	No	Common knowledge.
- Coefficients:	No	Some of these coefficients appear over optimistic. Results of follow up models being tested will provide more realistic values.
Calving rate: 85% by year	No	
Calf mortality: 10% by year	No	
Culling - cows: 20% by year 3		
heifers: 25% by year 3	No	
Mortality - (9 - 24mos.): 2% by year 2	No	
adults: 2% by year 2	No	
Daily avg. per cow: 1 lt per year/cow	Yes	
Lactation cycle: 290 days by year		
Stocking rate: 5 AU per hectare		

Table 4.6 cont'd

Parameters	Recommendation supported by project research	Comments
D. CALF REARING		
- Leave limited suckle of one teat's supply (2 lts). Eventually separate after 3 days colostrum feeding.	Yes	Depending on cow's genetic composition.
- Ration formulated to provide a crude protein value of 18% fed ad-lib until weaning at 8 - 10 weeks.	Yes	
- Feed good quality forage and 1.5 kg of ration daily until 21 weeks.	Yes	
- Male calves sold at weaning.	No	
E. FARM FACILITIES		
- Shed for housing with equipment and milk storage area constructed.	No	Practical observation.
- Keep heifers in loafing yard and calves penned.	Yes	
- Biogas digesters to be constructed, particularly where no electricity.	No	
- Pastures to have strong barbed wire peripheral fencing; later live fences.	No	Practical observation.

Table 4.7 Recommendations for different components of the modified rotational grazing system.

System Component	Recommendation Supported by Project Research	Comments
A. FORAGE		
(i) Production		
- Establishment of *Echinochloa pyramidalis* as pasture of choice. *B radicans* can also be used.	Yes	Management and pasture establishment work and further refinements
- *B. humidicola* or *B. decumbens* (606) suitable for intermediate savannahs.	Yes	Pasture of choice for satellite farms.
(ii) Carrying Capacity - E. pyramidalis 2 AU per hectare B. humidicola 1 AU per hectare B. decumbens (606) 1 AU per hectare - A. gayanus 1.5 AU per hectare	Yes	System capacity is higher because animals do not graze continuously but for part of the day.
(iii) Fertilization - Recommend 200 Kg N/ha and 175 Kg P205/ha split over 4 - 6 applications. In the intermediate savannahs, add more phosphorus.	Yes	Only token dressings have been used to date, recommended levels have not been applied yet.
(iv) Grazing - Grazing cycle of 3 weeks for lactating cows and young stock. 4 - 5 weeks for dry cows.	Yes	Currently 28 day cycles are being tried out at the model farms.
(v) Conservation - Feed silage only in dry season and not as a substitute for pastures.	No	Practical observation during experiments at Moblissa.
B SUPPLEMENTAL FEEDING		
- Rice bran, copra meal, wheat middlings or a combination of these is intended.	Yes	No clear cut results available, research continues.
- Assist in bridging dry spells, or to "challenge" the lactating cow; not as a substitute for grass.	No	
- Provide 14 - 14% crude protein, fed at 2 - 6 lbs/animal.	No	Based on existing knowledge, ARC tables.
- Upper limit of dry matter supplied by feed not more than .5% of body weight.	No	

System Component	Recommendation Supported by Project Research	Comments
C ANIMALS		
- Upgrade and select for a phenotype which can fully exploit favourable conditions for milk production.	No	
- Bulls to be kept by farmers and replaced every three years.	No	Common knowledge
- Coefficients:		
Calving rate: 85% by year	No	Coefficients appear too high, current follow-up observations at model farms should provide more realistic data.
Calf mortality: 5% by year	No	
Culling - cows: 20% by year 3	No	
heifers: 25% by year 3		
Mortality - (9 - 24mos.): 2% by year 2	No	
adults: 2% by year 2		
Daily avg. per cow: 1 lt per year/cow	No	
Lactation cycle: 290 days by year	No	
Stocking rate: 4.66 AU per hectare	Yes	Grazing is not continuous therefore pastures able to support higher stocking rates.
D. CALF REARING		
- Leave limited suckle of one teat's supply (2 lts). Eventually, separate after 3 days colostrum feeding.	Yes	Depending on cow's genetic composition.
- Ration formulated to provide a crude protein value of 18% fed ad-lib until weaning at 8 - 10 weeks.	Yes	
- Feed good quality forage and 1.5 kg of ration daily until 21 weeks.	Yes	
- Male calves sold at weaning.	No	Depending on farm's carrying capacity and farmer's cash flow.
E FARM FACILITIES		
- Shed for housing with equipment and milk storage area constructed.	No	Continuous grazing impossible, cattle rustling is a serious problem.
- Subdivisions into grazing units.	Yes	
- Biogas digesters to be constructed particularly where no electricity.	No	
- Pastures to have strong barbed wire peripheral fencing; later live fences.	No	Practical knowledge, too many free roaming animals tend to get into fields.

Table 4.8 shows the proposed number of head proposed for the model and the actual number at each of the farms being monitored.

	Model Proposal	Actual at farms being monitored
Model A	26	25, 16, 14, 11
Model B	51	62, 26, 17

a. The characterization of Model A and Model B farms seem to indicate that larger herds should have been considered in choosing the sample farms:

b. Characterized farms appearing in the 1991 Annual Report can not be traced back to those presented in the 1989 Annual Report and they are supposed to be the same.

c. Model A systems are designed for very small producers with limited land resources (0 - 2.5 ha), at stabilization the model requires 2.43 ha of pastures which totally ignores construction area (i.e. housing, shed and pen areas). No provision is made for pasture purchase activity. In fact, the model appears to be designed for a farm with a lower limit of 2.5 ha rather than an upper limit of that amount of land.

d. Analyses of the model done in current, rather than in real terms is mostly speculative since macroeconomic conditions are unstable and inflation was not really considered into the prices involved using more conservative figures for the technical coefficients and for the herd size, a simulation of the models was run using 1990 prices (i.e. at intervention). These results are shown in Tables 4.10 (coefficients are included in the Appendix 5).

For the NPV results, income flow was discounted at 10 per cent which may be considered high in real terms. Noticeable from these modified runs is that the Internal Rates of Return are substantially lower than those previously estimated and, for the cut and carry model A farm, the NPV of benefits without intervention is not much higher than that of the improved model.

It can be said that the rotational grazing model is much more attractive as an investment opportunity in the sense of substantially improving the net present value of benefits from the operation after intervention. Thus, the technology generated by the project appears to be more attractive to the medium size farmer.

Table 4.10 Estimation of Returns to proposed models

Model A Modified cut and carry

	Year After Intervention									
	1	2	3	4	5	6	7	8	9	10
Income	138,443	119,310	147,870	180,558	148,970	157,570	192,263	154,960	192,080	229,383
Costs	433,826	122,149	62,149	84,041	55,934	52,826	77,826	55,934	59,041	84,041
Net benefits	(295,383)	(2,839)	85,721	96,517	93,036	104,744	114,437	99,026	133,039	145,342

IRR % 22
NPV G$ 193,720
NPV W/O Intervention G$164,390

Model B Rotational grazing

	Year After Intervention									
	1	2	3	4	5	6	7	8	9	10
Income	365,566	399,940	448,480	561,971	572,020	639,820	788,856	742,830	742,830	769,176
Costs	1,009,152	353,414	324,624	394,887	299,887	303,940	349,887	299,887	299,887	349,887
Net benefits	(643,586)	46,526	123,856	167,084	272,133	335,880	438,969	442,943	442,943	419,289

IRR % 29
NPV G$ 800,519
NPV W/O Intervention G$266,060

Since the model works well in a mechanical sense, there should be a substantial effort to improve on the coefficients for both the biological aspect of the operation as well as those for the economic activities.

e. Labour in the farms after intervention is not all family labour but paid labour (albeit family labour) so that the inclusion of a returns-to-management category may be warranted.

The present model is in its initial stages and as such, should not be considered final. Therefore, close following of the monitoring activities coupled with a more indepth analysis of that has happened at the St Stanislaus farm will help to work out some of the current problems.

One final thought on the model relates to the disparity between the actual models in the field and the simulation model built to analyze them, only recently this has begun to be corrected.

4.6 Project Impact

Although the project, at this stage would not have been expected to cause any impact on the output of milk in Guyana, there are certainly other areas where benefits from the project are being reaped.

4.6.1 Institutional Linkages

On the institutional side, the MPS has allowed CARDI to continuously maintain a group of trained personnel in the area of animal production research around which the national institutions have rallied to develop a national programme for animal research. The impact of this cannot be assessed in merely economic terms (i.e. the savings by avoiding duplication) but in the wider sense of institutional recognition of the role that regional, as opposed to national research institutions can play within the agricultural development of CARICOM.

Perhaps because of its economic limitations, Guyana has understood that there are areas of research where CARDI is better suited to carry out while still not relinquishing the policy orientation that will reflect the country's needs.

During the first two phases, the linkages within the various institutions were relatively informal, although a great deal of effort was spent in coordinating project activities and disseminating results with the various institutions involved with the dairy sector. The third phase of the MPSP formalized this association and actually seems to have institutionalized an animal production research group such that, the original idea of coordination in dairy production research has been actually surpassed. Linkages with the Ministry of Agriculture and NARI have been strengthened through joint participation in many of the activities of the MPSP, each being responsible for certain areas of the projects research.

Linkages with the University of Guyana have allowed the project to benefit itself with the participation of work study personnel while at the same time providing them with the facilities for doing field training which otherwise would have not been possible.

Having transcended the milk production aspects, the project leader has been asked to prepare the National Livestock Research Programme currently in place. This could not have been accomplished by any one institution alone.

Linkages with MMA, LIDCO and NDDP on the milk production side have yielded invaluable two way cooperation, both allowing the use of their facilities or personnel for research and farmer training activities. The anticipated divestment of LIDCO will, in all likelihood, not impact on its relationship with CARDI and, on the contrary may help to strengthen the economic aspects of research in the livestock sector. The next stage of the project will require the

sustained linkages with NDDP to extend the technology that has been developed and tried out.

Finally, CARDI has, through this, and other projects established formal linkages with IICA whose Hemispheric presence has allowed for the availability of expert advise, technical back up and linkages with other on going livestock projects in the tropics.

A summary of institutional involvement is presented in Table 4.11 where it is appreciated that institution participation has had some changes as the project passed from Phases I to III. In the present Phase, there are 9 institutions with direct involvement in project activities which is an indication of the interest gained at the national level.

Table 4.11 Institution directly involved in project activities

	Institutions involved
Phase I	CARDI, IDRC, LIDCO, MOA
Phase II	CARDI, IDRC, LIDCO, NARI, MOA, MMA, UG
Phase III	CARDI, IDRC, IICA, LIDCO, NARI, UDDP, MMA, MOA, UG

On an international level, the project has permitted CARDI to participate in the RISPAL network gaining both, experience and providing research results that may be used elsewhere, as well as linking the MPSP with other projects within the network.

4.6.2 Methodological Issues and Projection

The confrontation of the systems approach with the existing conditions in Guyana and elsewhere has resulted in changes to the initial methodology of the approach. For one, the holistic approach to farmers problems, because of purely practical reasons, was not followed, concentrating efforts only on the milk production enterprise of the farm separate form other interactions within the "farm system".

Methodologically, the systems approach was not always strictly followed but, in an overall sense this has been the methodological approach to doing research at the MPS. There is no doubt that this has proven to be a successful way of going about research for livestock production in Guyana. The spin off of this project; the sheep production project, has adopted the systems methodology to perform its activities.

On a broader issue, the systems methodology with the modifications necessary to suit the institutional environment has been proven adequate to address animal

production systems development and can be used by CARDI or any other institution as their research methodology.

The participation of the project personnel in the RISPAL network has been extremely important in shaping up and refining the application aspects of the systems approach. This impact while difficult to measure is nonetheless beneficial in future applications of the methodological approach.

The activities conducted by the project have served as a general orientation for CARDI's involvement in the Animal Production Research in such a way that in their most recent budget, Animal Production related activities accounts for about 1/3 of the Institute's budget. The reinforcement of the Animal Production activities has resulted in an opportunity for CARDI to project its action to Africa by means of the former and actual Project Leaders be granted a leave of absence to collaborate in the implementation of the methodology of system approach in animal production.

4.6.3 Strengthening of CARDI's and Guyana's ability to obtain funding for other projects

The existence of a highly qualified cadre of personnel in CARDI's Guyana office provides a safeguard for other investments in animal production research. This, coupled with evidently successful results has helped to attract funds for at least three other projects.

a. The Pilot Project for increasing Milk Production among Small Coastal Farmers in Guyana, funded by CIDA from 1984 - 1986 which provided a characterization of the farmers on the Abary River.

b. The Sheep Production Program, funded by CIDA which has just begun operations and is using the systems approach methodology for conducting research.

c. The Forage Seed Production Program at Ebini funded by EDF was initiated on the basis of seed money and research by the MPS project.

Close collaboration between all institutions involved in animal production has no doubt improved their opportunities for obtaining project funding, either from external agencies or from the Government of Guyana.

4.6.4 Training

Perhaps the greatest single impact of the MPSP to Guyana's livestock sector to date, has been the training of Guyanese personnel in many aspects of livestock research. Training of CARDI, NARI and Ministry of Agriculture personnel by the project in either post graduate studies or practical training by being involved

in project activities, has resulted in the formation of a group of professionals currently working in project activities or related livestock research.

Table 4.12 shows the number of people involved in project activities from its inception.

Table 4.12 Number of people involved in project activities

Phase	Year	Total staff	Associated members
I	1982-83	6	3
I	1983-84	5	4
I	1985	5	5
II	1986	8	3
II	1987	11	3
II	1988	9	3
III	1989-90	8	3
III	1990-91	9	3

As the project has advanced into the Phases II and III, the number of people has increased denoting the interest that its activities have created. In Phase III, the project developed the Project Advisor concept that provides it with periodic visits from a highly experienced professional who makes a review of the activities conducted and advises in the necessary adjustments needed in the day to day work. From the start, the project has received the visit and advice of several Consultants who have made periodical evaluations, suggested operational changes and have provided technical advice on specific activities. Their participation in workshops has helped in the circulation and methodological aspects of project activities. (Table 4.13)

Table 4.13 Number and institutions involved in providing technical support to the project.

Phase	No of Consultants	Destination
I	4	IDRC, CATIE, CIAT, UWI
II	3	IDRC, IICA
III	7	IDRC, IICA

The contribution of the trainees is already bearing fruit in that Guyana can now fully staff and operate a solid livestock research programme without having to restore to outside personnel for day to day management of research activities.

It is expected that this core of people will continue to play a role in the development of Guyana's livestock sector, be it in the field of research, extension and policy orientation.

4.6.5 Dissemination of information

The impact of the project can also be assessed by the number and type of activities conducted during the successive phases. Table 4.14 shows the workshop activities held. It is noticed that every year this kind of activity has taken place. The workshop has been used to discuss the activities to be conducted and also to present the result of the previous year performance.

The use of a workshop type of activity has been the preferred one for it allows the opportunity for all participants to express their views, either on specific subjects or general issues. This follows the general recommendation of RISPAL where extensive and in depth discussions are considered an important approach to understanding the methodological issues. The mission feel this is the adequate type of activity and must be encouraged in the future.

Table 4.14 Workshop activities conducted by the project

Date	Subject	Participants
Feb-March, 1982	Design of project activities	20
July, 1983	Evaluation of project activities	30
October, 1984	End of Phase I, Regional Workshop	38
March, 1985	Planning and Proceedings for Phase II	20
May, 1986	Progress of project activities	---
November, 1987	Programming of Phase III	30
July, 1988	Project Progress and Results	---
October, 1989	Project Progress and Results	50
October, 1990	Project Progress and Results	50

Besides, field days have been conducted according to Table 4.15. Although the subjects are various and the need for this activity is a constant one, is not easy to quantify their impact because it will vary according to the use of the technology that has been discussed after a period of time. However, the first step in the process of transfer of technology is to expose the farmers to new ideas and to improved farming practices.

Table 4.15 Field days sponsored by the project.

Date	Subject
April 29, 1983 (25 farmers)	"Introduction to Pasture Establishment, Types and Species of Grasses and Legumes"
	"Concept of Stocking Rates"
October 25, 1983 (20 farmers)	"Pasture management"
June 1985 - 1986	"The use of scythe" Moblissa
June 1989-1990	"Calf rearing systems"
(8 farmers)	"Silage making"
(35 farmers)	"Herd health and tick control"
	"Grazing systems"

Finally, the impact of the project in disseminating information is through publications and active participation in different types of meetings. Appendix 6 presents a list of the subject matter discussed by project members at different occasions. This reflects the interest and dedication to dissemination of project results.

5 RECOMMENDATIONS

The evaluation team having analyzed the existing information on the project activities, the ecological and physical conditions of the different working areas, and the results of the interviews with the authorities of the national and regional institutions agree on the following recommendations:

A. Analysis and Publication of Results.

A very dedicated effort has to be made in order to extensively review what has been done and thoroughly discuss research results. This should be done by geographical area and type of experiment. It would be convenient to build a complete matrix and have each experiment catalogued on the type of problem it was supposed to address; have a clear definition of the objectives, recover the original data, and discuss each of the results in relation to the problem area. The following points must also be addressed: positive and negative results, was the experiment terminated before conclusive results were obtained?, and why?

This effort will result in a very good contribution to research in Guyana, and the collected information should be published to provide the basis for future planning, for extension purposes, and to avoid duplication of efforts in the future. It is highly recommendable that CARDI appoint a person responsible for this activity and a working schedule be discussed with the Project Advisor and a follow up mechanism be instituted where the collaboration of CARDI's headquarter scientists may be obtained.

Technical and other publications are a way through which the effort put into Guyana;s dairy sector will be disseminated and used in other countries within the Caribbean. The above information would serve as a basis for discussion in technical events oriented towards the planning and execution of milk production research for Guyana and Caribbean.

B. Characterization and Diagnosis Studies.

A great deal of information on farmer characterization has been collected, however the analysis of this information does not appear to be as complete as the effort expended in this activity would warrant, thus it is recommended that an in depth evaluation of the methods used in the characterization studies be done stating the initial objectives and the results obtained. In order to do that, it is suggested that the results be grouped by areas (Moblissa Satellite farms, Riverain area farms and Coastal area farms). Draw the general conclusions and make an effort to identify the existence of different recommendation domains. Some methodology used by other RISPAL projects may be of interest to do that. The results must be confronted with technical staff from the different areas for appropriate discussions.

C. Model proposal and modelling aspects.

Modelling has, for the most part been limited to reproduce prevailing conditions at the farms being monitored by project personnel. The computer model designed for this is mechanically adequate yet it lacks sophistication that can turn it into a useful tool for performing simulations. While the main thrust and effort of project personnel should be to collect, at the farm level, the coefficients within the different activities of the system, the model should be designed in such a way that it be possible to identify the critical parameters via simulation and sensitivity analysis.

The above requires that the computer model be expanded to include the technical coefficients of the different enterprises that comprise the cost categories included in the financial analysis section of the current model. There are various models available that can work for this but, it is recommended that a simple, yet complete model be devised for the Guyana project so that simulations can be run. In a model such as this, at least the following coefficients should be considered: labour by activity (i.e. pasture establishment, cutting, milking, etc.), rations (pasture, composition of concentrate, etc.), prices of all inputs, including labour, supplemental feeding, cut grass, veterinary supplies (by name), pesticides, spares, etc. This will allow users of the model to be able to identify key parameters that may have a great deal of influence on the economic behaviour of the model. As it is now, such analyses cannot be performed.

Since the information that is being collected has been regarded as incompleted in some aspects, according to different sources, a very detailed chronogram and type of information being obtained must be set. It is suggested that this updated chronogram be sent to the Project Advisor to secure his comments and to be ascertain that enough information will be available for the analyses. In this aspect the project may make an effort to obtain some comments from the RISPAL Secretariat and other persons they may feel may contribute to a better utilization of the information.

It is also suggested that more simulation studies be made on the effect of changing some of the technical coefficients upon total and economic performance. Some of these points have been already taken up.

It is suggested that the alternative models being tested be used by project staff to be confronted with technical staff from NDDP working at the regional level. This will provide an opportunity to advance into the next phase of the methodology which is the validation and technology transfer.

D. Assessment of Potential Benefits.

During this consultancy a quick ex-ante evaluation of benefits was attempted; unfortunately there was no data available at the project site in order to do, at least this preliminary analysis. It is recommended that measures be taken to assemble this information (expenditures by year and, as much as possible , by research component , contribution of other institutions, etc.) at the project site and an "ex ante" analysis of possible research benefits be done. This issue is important in the sense that, if future investments into the project are curtailed, those possible benefits may not be realized.

At the same time, it would serve for IDRC, CARDI, and all other institutions involved to realize the extent of returns to their investments made in milk production research.

E. Methodological Issues

During the life of the project a number of methodological issues have arised, the project has dealt with some of them but still many remain unresolved; it is suggested that during the remaining year of the project, the most important methodological issues be identified and their importance for animal production systems research be assessed for future use by Guyana, CARDI, and CARICOM scientists dealing with this subject. This exercise will also be useful to RISPAL as a collaboration to other projects, and to IDRC in their appraisal for funding projects.

F. Future Research

Future research should be concentrated on the coastal areas, however without neglect of the continuation of work in the Intermediate Savannahs. It should be clearly recognized that any project impact in the near future will come from the coastal farmers; as such these should constitute the major clientele.

Because animal production (beef and milk) is so important to the Guyanese and Regional economies and on-farm research is not carried always under conditions where researchers have full control over experimental parameters; on-farm research must be complemented with experimental research station. It is therefore recommended that Guyana look closely to the establishment and implementation of a central livestock research centre where the trials and experimental variables can be adequately managed. The ecological conditions at this proposed centre should approximate, as closely as possible the major livestock production zones in the Region. It should provide minimal facilities for the work be done in technically adequate conditions, including grazing land, an adequate number of animals for critical comparisons with corresponding

physical facilities, a small nutrition laboratory for routine analyses, means for compilation and analyses of data obtained and idonneous personnel.

The implementation of such an experimental research centre should be considered within the context of a National Animal Production Research Programme, with strong linkages to existing regional livestock programmes. An effort must be carried out for the identification of funds from donor agencies or multilateral financial institutions to achieve this objective.

Digestibility studies, although of great importance in animal research, are not the goal but only the means by which pasture and animal performance can be explained. Therefore results on these sort of trials ought to be used to complement forage, pasture evaluation, and stocking rate trials rather than independently.

On the other hand, emphasis should be given to the quantification of actual nutrient requirements of experimental animals and relate them to digestibility and any other metabolic or nutrition studies to be done.

The team has identified that cost of pasture establishment may constitute a hindrance to future adoption, therefore, it is recommended that special emphasis be given to establishment studies in which the overall cost of this activity may be reduced as well as the time required to incorporate new pastures into the production system. This latter aspect is of special importance for adoption of the technology by small producers with limited land resources.

Stocking rate and other animal production experiments can be very expensive so every effort should done to have adequate design and the experimental well chosen so data obtained is reliable and can be related to the practical situation occurring under farm conditions.

G. Future Activities in Guyana

Research activities have been an important component in the MPS project and should continue having a relevant place among total activities within any actions to improve milk production in Guyana. On the other hand , characterization and diagnosis studies have produced a substantial amount of data which when properly analyzed must be linked with research data to provide the basis for initiating the technology transfer activity on a large scale.

If the systems approach methodology is to be followed,
technology transfer must be on the basis of the models that are currently being tested especially the St. Stanislaus College farm for the rotational grazing system, and the Arya Pratinidhi Orphanage farm for the modified cut-and-carry system.

To implement the transfer of results it will be necessary to include NDDP as it is the institution responsible for dairy development in Guyana. Training of NDDP personnel in the technical aspects of the model farms can be done at the above mentioned farms.

The project should make every effort to maintain these model farms going on properly so that they can be used in the future for training not only technical personnel but also farmers and government technicians or students.

APPENDIX 1 List of documents available for review

1.	Agrilatte Sistemi	(1990) - Guyana Dairy Study
2.	Agrocarib 2000	(1991) - First International Conference on Financing Caribbean Agricultural Development
3.	CARDI	(1982) CARDI/IDRC Milk Production Systems (Guyana) Project. 1st Annual Report, December 1982.
4.	CARDI	(1983) CARDI/IDRC Milk Production Systems (Guyana) Project. 2nd. Annual Report, December 1983.
5.	CARDI	(1985) CARDI/IDRC Milk Production Systems (Guyana) Project. End of Phase I Report, December 1985.
6.	CARDI	(1986) CARDI/IDRC Milk Production Systems (Guyana) Project. 1st Annual Report, Phase II, June 1986.
7.	CARDI	(1987) CARDI/IDRC Milk Production Systems (Guyana) Project. 2nd. Annual Report, Phase II, June 1987.
8.	CARDI	(1988) CARDI/IDRC Milk Production Systems (Guyana) Project. 3rd. Annual Report, Phase II, August.
9.	CARDI	(1990) CARDI/IDRC Milk Production Systems (Guyana) Project. 1st Annual Report, Phase III, June.
10.	CARDI	(1991) CARDI/IDRC Milk Production Systems (Guyana) Project. 2nd Annual Report, Phase III, May.
11.	Caribbean Agricultural Research and Development Institute (CARDI)	Annual Repts, 1989, 1983/84, 1986/87, 1987/88.

12.	CARICOM	Caribbean Community Programme for Agricultural Development (1989). Vol. 1 Regional Action Plans.
13.	Cubillos, Gustavo F.	Consultant Report, September 1990
14.	Cubillos, Gustavo F.	Consultant Report, July 1989
15.	Cubillos, Gustavo F.	Consultant Report, November 1986
16.	Cubillos, G.F., Ganoza, V. and Pulgar, Vidal	Consultant Report on Milk Production, Marketing and Processing in Guyana, March 1991.
17.	Emona Inzeniring	(1988) - Feasibility study for Dairy Development Programme in the Cooperative Republic of Guyana (October).
18.	Livestock Development Company (LIDCO)	Performance Reports 1986, 1987, 1988 & 1989
19.	Munoz, H.	(1990) Visit Report - Milk Production Systems (Guyana) Project, Phase III, (June).
20.	Munoz, H.	(1990) Visit Report - Milk Production Systems (Guyana) Project, Phase III (November).
21.	Munoz, H.	(1991) Project Advisor Report. Milk Production Systems Project, Phase III, (March).
22.	NARI	National Livestock Research Programme (1988 - 1991).
23.	National Agricultural Research Institute (NARI)	Annual Reports, 1985, 1986, 1987, 1988 and 1989.
24.	Osuji, P.O.	(1982) Proc. Milk Production Systems. Project Design Workshop.

25. Ralph, E.L. Development of Simulation Model for dairy cattle management to its application to the Moblissa herd in Guyana. MPh Thesis, UWI, 1989.

26. Ruiz, Manuel E. Consultant Report, July 1989

27. Seaton, J.M. Grazing and supplementation studies with growing and lactating dairy cattle at Moblissa, Guyana. MPh Thesis, UWI, 1989.

28. Wickham, C. Some effects of harvesting on seed production and phosphorus and calcium nutrition on initial seedling growth in Centrosema acutifolium (Benth). MPh Thesis, 1988, UWI, 1989.

APPENDIX 2 List of field trips taken by the mission.

1 Coastal Research Station
National Agricultural Research Institute
Burma, Guyana

2 Gold Digging Dairy Operation
Livestock Development Company
West Coast Berbice, Guyana

3 Kabawer Ranch
Livestock Development Company
West Coast Berbice, Guyana

4 Moblissa Cattle Farm
Livestock Development Company
Moblissa

5 Mr Ernest Speller Farm
Timehri

6 St Stainstaus College Farm
Bel Air, Georgetown

7 Poorau Singh Farm
Craue Village, West Bank Demerara

8 Arya Pratindhi Orphanage Farm
Units, Mahaica

9 Latchman Singh Farm
Novar, Mahiacony

10 Prakash Dayal Farm
Crane Village, West Bank Demerara

APPENDIX 3 List of authorities and persons interviewed.

Dr Patrick McKenzie	Senior Minister Ministry of Agriculture Georgetown, Guyana
Dr Steve Surujbally	Director, National Dairy Development Programme (NDDP), Georgetown, Guyana
Dr Michael Granger	Director National Agricultural Research Institute (NARI), Mon Repos, Guyana
Mr Lennox Adams	Assistant Divisional Head State Planning Secretariat Georgetown, Guyana
Mr Ronald Gordon	Officer-in-charge, Agricultural Development Section CARICOM, Georgetown, Guyana
Mr Nigel Durrant	Senior Agricultural Economist CARICOM, Georgetown, Guyana
Mr Cam Bowes	First Secretary (Development) Canadian High Commission Georgetown, Guyana
Miss Pat Bender	Head, Planning Division Ministry of Agriculture Georgetown, Guyana
Mr John Browman	Dean, Faculty of Agriculture University of Guyana Georgetown, Guyana
Dr James Smith	Project Leader and Representative CARDI, Guyana
Mr George Buckmire	Representative Interamerican Institute for Cooperation on Agriculture (IICA), Georgetown, Guyana
Mr Peter Ramsammy	Agronomist - IICA

Dr Peter Davis	Animal Productionist - IICA
Mr Julien Seaton	Animal Productionist - CARDI
Mr Nigel Cumberbatch	Animal Productionist - CARDI
Mr Claudius Wickham	Forage Agronomist - CARDI
Mr Earl Thom	Technical Assistant - CARDI
Mr Autry Haynes	Technical Assistant - CARDI
Dr Hector Muñoz	Animal Production Specialist Project Principal Advisor, IICA, Suriname
Dr Pascal Osuji	Animal Nutritionist and Coordinator, Cattle Milk and Meat Thrust International Livestock Centre for Africa (ILCA), Ethopia, Africa

APPENDIX 4 Analyses of the individual trials and activities conducted by the Project

A.4.1 Phase I

The project activities were defined in a Design Workshop held on April 1982 at Georgetown where Consultants and members of CARDI and national institutions made the recommendations for action.

From this workshop nine activities, or rather lines of action, were proposed to be initiated.

a. Comparison of calf rearing systems. This was to compare two systems to the existing LIDCO system with the aim of devising a way of rearing earlier, faster growing, healthy calves in an economically efficient manner.

   The activities on this line resulted in the comparison of essentially four methods of calf rearing:

   1. The existing LIDCO system which essentially fed milk for only 3 weeks prior to allowing calves to graze. Weaning at 16 weeks of age, and limited supplemental feed before weaning.

   2. Feeding rice bran and cut forage to the calves after collostrum feeding for 3 days. Weaning at 8 weeks.

   3. Feeding commercial calf starters and cut forage to calves after collostrum feeding and calf grower during the later stages.

   4. LIDCO's system modified for later grazing i.e. feeding cut forage rather than setting out to graze.

   It was perceived by the experts that LIDCO's system involved too much milk consumption and – although not explicitly mentioned – that keeping calves in individual stalls might have been inappropriate. Based on the results of this experiment, it was recommended that work should continue on the early weaning systems with commercial rations or with a rice bran/fish meal/vitamin diet. This in fact was done but the results were never published.

   From the economic point of view two aspects come to mind, one was that the difficulty in ensuring adequate and continuous supply of commercial calf starter and grower feeds, because of lack of foreign exchange, transportation infrastructure, etc. ruled out their use (not necessarily on strictly pecuniary costs but on indirect and nonpecuniary and transaction

costs, import licenses, and risk) for at least the small farmer. The other is that locally available sources of feed had to be further explored if a viable alternative to the LIDCO and small farmer calf rearing systems was to be found.

Findings of the trials, as indicated in the End of Phase One Report (Dec 1985) confirmed this and pointed out to the fact that no economically technical alternative had been found to substitute the existing calf rearing systems.

Economic analysis done for the trials was adequate since it was obvious that the least cost alternatives turned out to be the most expensive in terms of mortality rates. On the other hand however, the economic characterization of existing calf rearing systems appears deficient in the characterization studies for, whilst the technical aspects are clearly defined, the parameters and costs for the system are not available.

However this trial served to demonstrate that there is room for improving the LIDCO calf rearing system provided adequate feed ingredients are available at reasonable prices.

From the technical standpoint, results to this trial could have been forecasted provided feed nutrient composition had been available. There was no reported data on gross or digestible nutrients consumed, and they constitute a condition or pre-requisite for trials of this sort.

Interpretation of results when pre-requisites are accomplished are solid enough to save time with future work of the same sort.

On the other hand, achievements or conclusions to this trial reported at the end of Phase I (December 1985) seem obvious and could have been forecasted provided feed nutrient composition had been available. There was no reported data on grass or digestible nutrients consumption, but just considering a rough estimate of the dry matter intake consumed by animals on the various treatments, animals on treatment D (T_3) were the one having the greatest amount consumed followed by animals on treatments C (T_2), B (T_4) and A (T_1). The quality of dry matter consumed by animals on treatments A (T_1) and B (T_4) – due to the total amount of milk supplied – would have been higher than in the case of animals on treatment C (T_2). Quantity of dry matter consumed by animals on treatment D (T3) was supplied partially by milk and partially by the starter and grower concentrate supplied which, on theory, would have been balance, or at least better balanced than supplemental feed used for animals on the other treatments.

This trial also helped to identify that pneumonia is a major cause of death at early ages of animals although none of the later available reports pertaining to the MPS Project deals with this problem.

b. Soils, to assess soil fertility and determine economic optimum fertilization.

On this account, characterization of prevailing soils at Moblissa was done to evaluate natural fertility and acidity. The implications of the results of this activity indicated that all plant nutrients must be added after the area had been limed. Furthermore, it was suggested that fertilizer applications should be at low rates but with high frequencies. It was indicated that greenhouse work using the level of sufficiency required for nutrient elements resulted in fertilizer base level recommendations. These results however were not published nor available to the evaluation team.

Although future field fertilizer trials were planned for subsequent years, these were not implemented.

From an economic standpoint, it is common knowledge that fertilizers and micronutrients were both expensive and not readily available for livestock activities in Guyana at the time the first phase was completed, thus pursuing this avenue further would probably have resulted in economically inefficient optimum technical requirements. However, the lack of detailed published results or information on fertilizer and nutrient requirements for the intermediate savannahs of Guyana leaves, somewhat, the impression of an incomplete exercise considering the projects goals and methodology.

c. Germplasm collection and evaluation for collection, maintenance and evaluation of potential forage legumes and grasses.

d. Evaluation of Pasture Management systems to determine the optimum stocking rates at two fertilizer rates.

These two lines of action essentially complemented each other in the way they were carried out; the first tended to measure some of the parameters needed to manage promising material (dry matter yields, response to grazing, cutting intervals, etc.) while the second was more of a specific response to fertilizer by the most promising pasture grasses.

The results tended to confirm that:

1) *Brachiaria humidicola,* which was already established in Moblissa was one of the most promising grasses and,

2) Fertilizer application in small but frequent doses were required for the soils of the intermediate savannahs.

No economic analysis was done for these two lines of action, then again, it was unnecessary.

On the second line three sets of grazing studies were undertaken.

1) Comparison of milk production potential at a fixed stocking rate for the three most promising grasses.

2) Effect of four stocking rates on the milk production of cows grazing *B. humidicola* pastures.

3) Response of three grasses to grazing by replacement bulls and heifers.

The trials, while not fully completed during Phase I provided valuable information on alternative pasture management systems. It must be stressed that the stocking rates considered did not approximate those used at the Moblissa State owned farm (2.6 AU/hectare).

No record of costs or other data (prices of milk, cattle, etc) is indicated such that the economic analysis of the proposal alternatives once the trials were over *vis a vis* current system practices was impossible.

e. Legume/grass associations to evaluate various combinations of grasses and legumes for persistence, productivity and nutritive value at varying grazing intensities.

f. Legume protein banks to compare various legumes as protein banks.

The evaluation and start up of these lines of action did not prove to be feasible at the time of the first Phase.

g. Forage conservation to determine various forage, conservation methods (silage, dry grass) and to determine their consumption and nutritive value.

Results of this phase were preliminary as some of the technical problems were just being worked out by the end of the phase.

h. Cash crop/forage to compare two systems of pasture establishments: conventional and crop rotational system.

This line of action was not pursued for unknown circumstances. From a strict systems approach methodology this should not have been the case since cash flow was a serious limitation in the satellite farms at Moblissa.

i. Monitoring studies to evaluate technically and in economic terms the prevailing systems at both the state and small farms at Moblissa.

This line of action was the characterization step required by the systems methodology and, while it might have aptly designed to evaluate technically the prevailing systems it was certainly not possible, with the information available or proposed to be collected to analyze the systems in economic terms.

For one, no labour coefficients appear to have been collected for any of the activities involved in the systems; time dedicated or available to dairying vs. other activities for the satellite farmers is also not available. Finally prices nor other relevant economic information appear to have been collected.

A serious economic analysis of the Moblissa State Farm, even under the prevailing economic system at that time, should have been carried out, much in the same fashion as the environmental (soil and rain), and technical evaluation of the system was done. To date this has not been done and, as such, the validity of technical solutions found to the constraints of pasture based systems in the intermediate savannahs is yet to be confronted in economic terms.

A.4.2 Phase II Intermediate Savannahs

The lines of action for the Moblissa area were determined in a workshop carried out to evaluate the activities of Phase I and a subsequent workshop to plan, and program the activities for Phase II.

a. The germplasm collection and evaluation to continue the introduction, identification and evaluation of suitable grasses and pasture legumes for the Moblissa ecozone.

   This line was pursued for two years during the project, and consisted mainly of response to grazing (CIAT, C type) trials by six grasses during the two seasons for light periods. These trials completed the cycle for promising grass evaluation.

   During this Phase, legume pastures could still not be established properly and the idea appears to have been abandoned although there is no record of this.

b. Seed production to multiply and maintain the viability of seeds for 14 forage legumes and two pasture grasses.

   The activity on this aspect has been limited to producing forage legume seeds from the nursery plots and a trial by the Ministry of Agriculture Seed Unit.

c. Protein Bank studies to evaluate the role of a legume as a source of protein.

Nothing was reported on this activity.

d. Monitoring studies for the continued assessment of the farming systems employed at the site to determine the relationships of different variables and the impact of intervention and variations.

This activity continued for only one year after the First Phase and was ended in 1985. The LIDCO farm as well as the satellite farms were characterized and alternative systems proposed for calf, heifer and milk production. It is beyond the scope of this review to evaluate each individual recommendation, however the following aspects are somewhat doubtful.

1. Current stocking rates were considered to be low yet the project continues, to this date, to run some stocking trials at lower rates.

2. Calf rearing systems supposedly more economical than the existing one were recommended however, expected results can not be easily traced back to any trial carried out during this or the previous phase. Reported costs ignore the risk factor involved in obtaining calf starter and calf grower rations.

3. Heifer production recommendations are not based on experience arising from trial or experimental data published by the project and appears to be only speculative in the absence of any such confirmation (recall no replacement heifer studies were carried out during the first phase).

4. Economic evaluation of heifer production systems is confusing and not based on previous trials or information arising from the first phase.

5. The simulation exercise carried out for the satellite farms was not implemented.

e. Stocking rate trials to determine the carrying capacities and optimum stocking rates for heifers grazing *B. humidicola* pastures.

Two stocking rate trials were carried out during this phase. The first was carried out in 1986 and resulted in the thesis of Mr J. Seaton with a recommended optimum of 5.4 AU per ha.

The second was conducted during the dry season and animals were supplemented with silage and gave an optimum stocking rate of 1.3 AU per hectare with a gain of 298 gms per animal. This result is only theoretical since stocking rates were much higher than the optimum and the animals were all losing weight on this trial.

The economic implications of these trials have not been adequately analysed, during the rainy season there is excess forage which can either be silaged or used for meat production. Given the transportation difficulties in Guyana and the comparative advantage of Moblissa in this regard the profitability of a double purpose operation could be studied. At the same time, if there is to be a specialized dairy operation in Moblissa the constraints to silage adoption by farmers must be analysed in depth.

f. Supplementation of replacement dairy heifers to compare the performance of replacement heifers grazing *B. humidicola* with varying supplementation regimes.

g. Supplementary feeding of dry and lactating cows to compare the performance of dairy cows on varying supplementary feeding regimes.

No activities were carried out on these lines of action.

h. Forage conservation to determine appropriate conservation methods and techniques for the Moblissa ecozone.

The trials carried out in Moblissa were successful in identifying grass species for silage in solving the minor technical problems, and in producing good quality silage. However, they were not successful, from an economic point of view, since to this date, very few farmers – even in the coast – use silage to supplement during the dry season.

i. Calf rearing to devise cheaper calf rearing systems based on a reduced liquid milk diet.

j. Extension and developmental activities to assist farmers in the acquisition of necessary inputs and promotion of appropriate technologies.

These lines of action were not carried out during this phase.

In a sense, the activities of the project in the Intermediate Savannahs tend to reflect the decline of dairying at Moblissa. From a purely financial standpoint it would have probably been acceptable if the project had withdrawn from Moblissa after the first year, however, the slow phasing out of activities, the only one remaining being the stocking rate trials, has most likely been the most economically sound decision in the long run. Remaining in Moblissa has allowed the project access and commitment of other institutions which had to remain operating in Moblissa (LIDCO, NARI, Ministry of Agriculture) as well as credibility with the farmers.

Coastal Area

It is not stated in the documentation available why the second phase of the project was to involve the Coastal Area as well as the intermediate savannahs. It is clear however that the potential impact of these efforts were not going to be realized through the continuation of activities limited to the Moblissa area. For the Coastal Area the following lines of action were proposed:

a. Static Diagnosis to characterize farms on the Coast.

Keeping in line with the system approach methodology, this activity was initiated early on into the project by carrying out first a "sondeo" which allowed quick characterization and identification of constraints and following this with a farm survey on selected farms which yielded a more in-depth characterization.

These two studies yielded the basis on which the emphasis of component research was to be initiated.

Based on the findings of the sondeo and farm surveys it seems rather surprising that research on management of *Echinochloa pyramidalis* pastures did not begin earlier into this phase of the project. There appears to be certain fixation on the CIAT pattern of testing forage species (type A, B, C and D trials) prior to beginning on-farm research which was followed during the first two years of the second phase regardless of the evidence that what the farmers needed were techniques on how to manage the pastures they already had.

From the results reported, little attention was paid, in these initial characterizations to socio-economic variables (ethnic background, labour distribution between activities, role of family and women labour, primary sources of income, etc). On the whole it appears that these studies did not orient component research to a large extent as called for if the systems approach methodology were to be followed strictly.

b. Dynamic diagnosis to continuously monitor and update farm data and on-farm systems.

These monitoring studies yielded the identification of the prevailing milk production systems in the coastal area. The systems however seem to be incomplete from an economic standpoint in that they do not include resource flows, prices paid, and inter-farm enterprise flows which could have helped to better identify the economic reasons behind some activities and dynamic diagnosis studies appear to have been carried out on the assumption that the choice of production system depended largely on technical endowments or limitations rather than on social and economic issues as well. While the former appears to have played an overwhelming

role in the choice of milk production systems in the Coast of Guyana, the latter aspects should not have been neglected.

c. Preliminary systems alternative design and ex-ante economic analysis to specify production systems alternatives and develop economic profiles.

Three systems for the Coastal area were designed. These reflect adequately the predominant systems in which the project could effect some impact, either through better management, utilization of project research results, or by incorporating proven techniques used elsewhere.

There are no published record of the components of each of the systems nor of economic profiles for them.

d. Germplasm collection and evaluation to identify, introduce, and evaluate suitable pasture species for the Coast and develop appropriate techniques for their establishment.

Two types of nurseries representing the major soil types in the Coast were established, two drained acid soil nurseries and a saline soil nursery. The drained acid soil nurseries remain well established to this date but the saline soil nursery has disappeared. The establishment of nurseries and the associated methodology for testing pastures seems to have distracted the focus of attention of project personnel from a systems approach to research to that of an accepted scientific stepwise approach to evaluation. It is certainly a major surprise to discover that stocking rate trials for *E. pyramidalis* began in October 1987, a full two years after the sondeo and farm surveys had identified it as the major species of the improved pastures in the Coastal zone.

Reaching this stage at such a late date can be attributed to the strict following of the CIAT methodology thus:

Type A trials began at planting in November 1985
Type B trials were initiated in March 1986
Type C trials were initiated in June 1988
Type D trials were initiated in October 1987

e. Development of evaluation to provide a basis for assessment of project impact.

As important as this line of action appears to have been for the later stages of the project, no activities were undertaken on it.

f. Land preparation, fencing methods, planting methods, weed and pest control, fertilizer, soil amelioration to evaluate alternative pasture

establishment methods, and timing, and select, based on economical criteria, pasture establishment methods.

Trials were conducted for vegetative and germinative propagation of legume seeds. based on the experience acquired by one of the project fellows trained at CIAT, biochemical assessment of seed viability prior to planting has become a normal standard in any of the legume establishment attempts.

An experiment evaluating fertilization, height of cutting and rainfall on dry matter yields of *E. pyramidalis* was carried out. This trial was prolonged into the third phase and valuable management knowledge gained by this experience has cropped up in the alternative models proposed for coastal farmers.

There is no evidence that any of the other activities proposed were carried out, thus, the recommendations given later on in the project for individual components of the model do not necessarily reflect the most economically efficient way of carrying them out.

g. Hay, silage, solar drying forage conservation to identify and design appropriate forage conservation methods.

This line of activity produced excellent results from the technical standpoint and a true solution for bridging the gap between the two rainy seasons. However, to this date even project farmers have not adopted silage as part of their system. The limitation to adoption most likely lies in the lack of equipment for adequately chopping the forage prior to ensiling.

From an economic standpoint, the requirement of capital equipment for a particular activity must be viewed as an investment alternative and analysed as such. The silage problem has been viewed only from the technical stance and not in an economic sense.

h. Calf rearing to devise cheaper calf rearing systems based on a reduced liquid diet.

This is a second attempt at finding alternatives to the calf rearing systems prevalent in Guyana. Those at the Coast were not so different from those at Moblissa.

Project documentation is unclear as to whether or not this line was pursued; the First Annual Report of Phase III (June 1990) reports results of a trial of this nature. Considering that there was no report for the final year of Phase II nor a final Phase II report, it is possible that some activities were initiated on this line of action.

A.4.3 Phase III

a. Comparison of systems in the East Coast to assess performance of the proposed system.

This line of action was to compare proposed systems to existing systems for milk/beef production, forage utilization, reproductive performance and profitability.

Characterization of the farming systems established between the eastern bank of the Mahaica Creek and Onverwagt were done as of April 1985 starting with a rapid reconnaissance survey (sondeo) for selecting farms which will represent farming conditions in that area. Results obtained gave a very good idea of the potentiality of the whole area and of the actions to be taken for improving livestock production performance. Nutritional as well as management problems were detected.

In sum this activity represents a good background for initiating technology transfer actions. Actually the use of the Simulation models approach may be a good tool for prioritizing the various actions that eventually may be taken for developing this area.

While the follow up of the participating farms is quite rich on biological aspects,it is not so in economic data (economic data is considered to be equivalent to financial data) and as such little sensitivity analysis can be performed with the current simulation models.

On the operational side, farmers have adopted the models and followed technical recommendations closely which seems to indicate that they are comfortable with the proposed system and with the potential benefits which will be derived from its application.

b. Testing and validation of an intensive production system.

The title of this line of action reflects that there are still conceptual misunderstandings on the methodology being used, the trials carried out on this account however leave no doubt that the research activities on this line were in support of the management and information requirements of the proposed systems for the coastal area.

To that effect, trials to determine response to grazing, stocking rates, cutting heights and frequencies, and response to Nitrogen were carried out. These have provided valuable information for the proposed system parameters.

For the Intermediate Savannahs, a forage/legume pasture has finally been established and growth of heifers is being measured.

c. Germplasm introduction and evaluation to collect, maintain, and evaluate potential forage legumes and grasses.

Work continued on promising species as CIAT C type grazing trials were carried out on five grasses and new accessions were added to the acid clay coastal soils nursery at Burma.

A comparison of growth performance of six forages in saline and acid clay soils was completed; suitable varieties for the saline soils still have to be identified.

d. Seed production.

Seed production was conducted jointly with another project funded by the European Development Fund at Ebini with the objective of multiplying seed for experimental and pasture development purpose.

Given the actual costs of establishing *E. pyramidalis* pastures, a closer economic appraisal of the seed production activity should be undertaken for the coast.

Little has been done on the economics of pasture establishment and on the availability of seed (vegetative or germinative) for this matter.

e. Development of a health calendar.

Nothing has been done to date along this line of action, however, characterization studies indicate that health problems are somewhat important as a major cause of death losses among calves.

f. Milk and beef marketing study.

As the project has advanced towards the later stages of a systems approach to solving farmer problems, constraints outside the system must also be considered, particularly as they refer to making the system unprofitable. The concentration of the project on research activities during these three phases has by force limited its involvement in the policy issues.

In a country such as Guyana this is a most important factor that must be looked at carefully in the next few years if any impact form the project is going to be achieved. This is particularly true given the actual macro economic and sectoral policies being implemented by the country.

A milk marketing study identified the problems in the milk market as being more related to structural constraints than to supply and demand issues, as such, with the liberalization of the Guyana economy, a period of instability in the dairy market may arise and demand for project assistance may rise substantially.

APPENDIX 5 Technical Coefficients and Herd Development for Alternate Models

Modified Cut-and-Carry System (Model A Farms)

Technical Coefficients	Before Interv	Years 1	2	3	4	5	6	7	8	9	10
Calving Rate %	40	50	60	65	70	75	80	80	80	80	80
Calf Mortality %	25	15	10	10	10	10	10	10	10	10	10
Hiefer Mortality (9 - 24 mths) %	10	5	2	2	2	2	2	2	2	2	2
Heifer Mortality (2 - 3 yrs) %	10	5	2	2	2	2	2	2	2	2	2
Steer Mortality (9 - 24 mths)	0	0	0	0	0	0	0	0	0	0	0
Steer Mortality (2 - 3 yrs)	0	0	0	0	0	0	0	0	0	0	0
Adult Mortality %	10	5	2	2	2	2	2	2	2	2	2
Culling cows %	5	50	25	20	20	20	20	20	20	20	20
Culling bulls %	0	100	0	0	100	0	0	100	0	0	100
Culling heifers (2 - 3 yrs) %	0	30	25	25	25	20	20	20	20	20	20
Lactation length (days)	400	290	290	290	290	290	290	290	290	290	290
Average Milk Production/Cow (L)	2.0	4.0	5	5	6	6	7	8	8	9	9
Average Production/ Lactation (L)	800	1160	1305	1450	1595	1740	2030	2320	2320	2610	2610
Milk fed to calves/day for 8 wks	2	2	2	2	2	2	2	2	2	2	2
Stocking rate (AU/ha)	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03
Dry Matter Yield (kg/ha)	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000

Herd Summary	Before Interv	Years 1	2	3	4	5	6	7	8	9	10
Herd Composition											
Bulls	1	1	1	1	1	1	1	1	1	1	1
Milking Cows	8	8	10	10	9	7	7	7	7	8	8
Calves	5	5	4	6	6	5	5	5	5	5	5
Heifers (9 - 24 mths)	1	3	3	2	3	3	3	3	3	3	3
Steers/Bulls (9 - 24 mths)	0	0	0	0	0	0	0	0	0	0	0
Heifers (2 - 3 yrs)	1	0	2	1	0	1	1	1	2	2	2
Total Herd	16	17	20	20	19	18	17	17	18	19	19

Rotational Grazing (Model B Farms)

Technical Coefficients	Before Interv	Years 1	2	3	4	5	6	7	8	9	10
Calving Rate %	40	45	50	60	70	75	80	80	80	80	80
Calf Mortality %	20	15	10	5	5	5	5	5	5	5	5
Hiefer Mortality (9 - 24 mths) %	10	5	2	2	2	2	2	2	2	2	2
Heifer Mortality (2 - 3 yrs) %	10	5	2	2	2	2	2	2	2	2	2
Steer Mortality (9 - 24 mths)	0	0	0	0	0	0	0	0	0	0	0
Steer Mortality (2 - 3 yrs)	0	0	0	0	0	0	0	0	0	0	0
Adult Mortality %	10	5	2	2	2	2	2	2	2	2	2
Culling cows %	5	25	25	20	20	20	20	20	20	20	20
Culling bulls %	0	100	0	0	100	0	0	100	0	0	100
Culling heifers (2 - 3 yrs) %	0	30	25	25	20	20	20	20	20	20	20
Lactation length (days)	400	290	290	290	290	290	290	290	290	290	290
Average Milk Production/Cow (L)	2	4	5	5	6	6	7	8	8	8	8
Average Production/ Lactation (L)	800	1160	1305	1450	1595	1740	2030	2320	2320	2320	2320
Milk fed to calves/ day for 8 wks	2	2	2	2	2	2	2	2	2	2	2
Stocking rate (AU/ha)	4.66	4.66	4.66	4.66	4.66	4.66	4.66	4.66	4.66	4.66	4.66
Dry Matter Yield (kg/ha)	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000

Herd Development

Herd Summary	Before Interv	Years 1	2	3	4	5	6	7	8	9	10
Herd Composition											
Bulls	2	2	2	2	2	2	2	2	2	2	2
Milking Cows	29	38	36	35	33	31	30	31	31	31	30
Calves	12	11	17	20	23	23	23	22	23	23	23
Heifers (9 - 24 mths)	4	6	6	9	10	12	12	12	11	12	12
Steers/Bulls (9 - 24 mths)	0	0	0	0	0	0	0	0	0	0	0
Heifers (2 - 3 yrs)	4	3	4	3	6	6	8	7	7	6	7
Total Herd	51	60	65	69	74	74	75	74	74	74	74

APPENDIX 6 List of Publications by Project Staff

Theses

RALPH, E.L. 1989. Development of a Simulation Model for Dairy Cattle Management and its application to the Moblissa Herd in Guyana. U.W.I., St Augustine.

SEATON, J.M. 1989. Grazing and Supplementation Studies with Growing and Lactating Dairy Cattle at Moblissa, Guyana. U.W.I., St Augustine.

WICKHAM, C.V. 1988. Some effects of harvesting on seed production and phosphorus and calcium nutrition on initial seedling growth in *Centrosema acutifolium* (Benth)
U.W.I., St Augustine.

Papers and Articles

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*Submitted to Turrialba.

APPENDIX 7 List of Consultants to the Project

DATE	NAME	INSTITUTION
03-1982	Li Pun, Hugo	IDRC, Bogotá, Colombia
03-1982	Borel, Rolain	CATIE, Turrialba, Costa Rica
05-1984	Li Pun, Hugo	IDRC, Bogotá, Colombia
05-1984	Paladines, Oswaldo	CIAT, Cali, Colombia
03-1985	Archibald, Keith	UWI, Trinidad and Tobago
06-1986	Rankine, Lloyd	UWI, Trinidad and Tobago
11-1986	Cubillos, Gustavo	IICA, Guatemala, Guatemala
07-1987	Ruiz, Manuel	IICA, San José, Costa Rica
07-1987	Cubillos, Gustavo	IICA, Guatemala, Guatemala
07-1989	Cubillos, Gustavo	IDRC, San José, Costa Rica
07-1989	Ruiz, Manuel	IICA, San José, Costa Rica
09-1990	Cubillos, Gustavo	IDRC, San José, Costa Rica
02-1991	Cubillos, Gustavo	IDRC, San José, Costa Rica
02-1991	Ganoza, Víctor	IDRC, Guatemala, Guatemala
02-1991	Pulgar-Vidal, Javier	IDRC, Brookings, S.D., USA